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Vol. XXI FEBRUARY, 1916. No. 2

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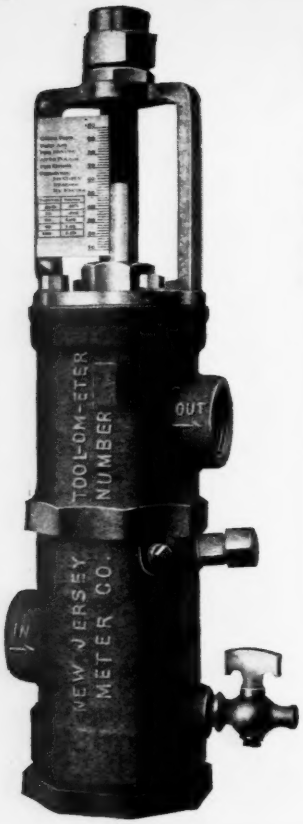

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by Edmund M. Ivens, B. E., M. E.

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EVERYTHING PNEUMATIC.

Vol. XXI FEBRUARY, 1916 No. 2

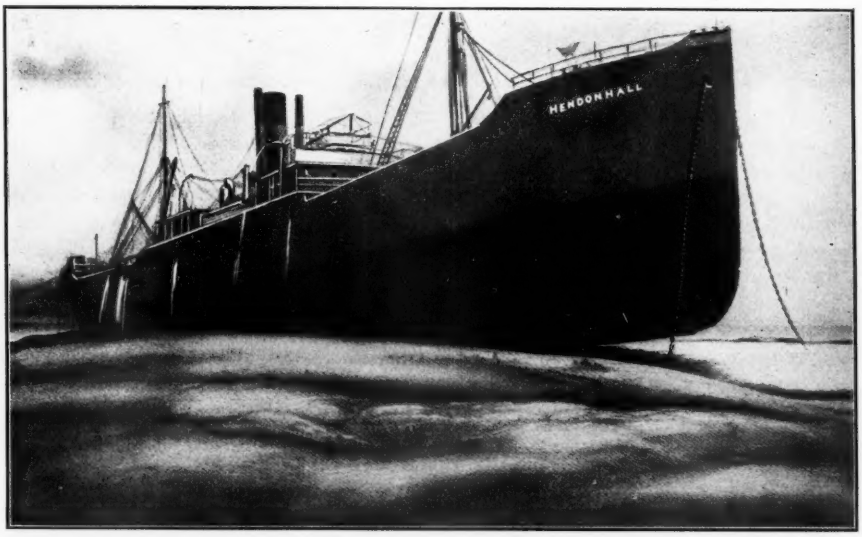


FIG. I. ON THE ROCKS—LOW TIDE.

THE REFLOATING OF THE HENDONHALL

This steamer owes its existence at the present time entirely to the good offices of compressed air. In November, 1914, she ran upon the rocks at high tide between Trinity Bay and Point des Monts in the lower St. Lawrence. The two half tones here given show her at high tide and at low tide, respectively. Large holes were torn through her bottom amidships so that the tide flowed freely in and out. Her condition for salvage was apparently so hopeless that nothing was done for seven or eight months.

About the middle of July, 1915, the Canadian Salvage Association, licensee of the Yankee Salvage Association, of New York City, took the job of getting the ship free so that she could be towed to Quebec. Mr. W. W. Wotherspoon, the well known wrecking expert, was in charge of the operations, and on August 26, nine months after she went ashore, the Hendonhall was refloated.

To enable the steamer to clear the rocks at high tide, its rise and fall being accurately known, it would be necessary to so lighten her as a whole that she would float at practically her "builder's light draft," or as she would be without freight, without coal, without water in either her boilers or the double bottom. Fortunately it happened that while the middle hold was open to the sea the ends

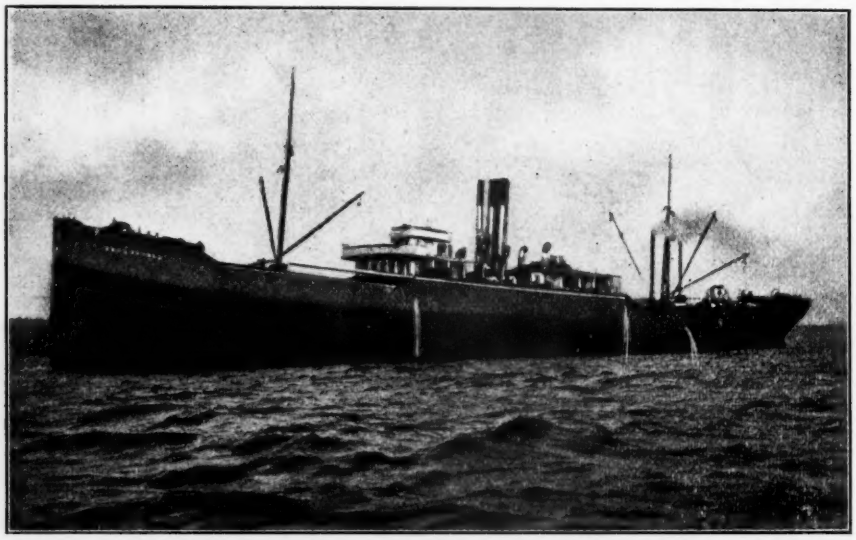


FIG. 2. ON THE ROCKS—HIGH TIDE.

both forward and aft were still so tight that they could be pumped dry, which was accordingly done, the boiler water, ballast water, and 500 tons of bunker coal being also got rid of. It was only necessary then to expel the water from the damaged hold, which was done by the use of air pressure. The space in which the water was to be displaced by the air admitted above it was 80 ft. long, 48 ft. beam and 27 ft. deep, there being no 'tween decks. The hatches were secured and made air tight and the deck and bulkheads were braced to resist the anticipated pressure and the compressor was connected and set to work.

The compressor used, shown in the half tone, Fig. 3, was an oil engine driven compressor known as Ingersoll Rogler, Class E R O. The oil engine and compressor cylinders are tandem or straightline with a common stroke of 10 inches. The former is 12½ inches in diameter and operates on the "two-cycle" principle. The compressor cylinder is 10 inches in diameter, double acting with a piston displacement, at 300 revolutions per minute, of 261 cubic feet. The compressor is capable of compressing and delivering air up to 100 pounds per square inch, and the fuel consumption is then about 3½ gallons per hour, but as in this case the pressure required did not exceed 6 pounds, this figure was materially lower.

The compressor, which, it must be conceded, was of rather small capacity for the work required of it, made a record run worth noting. It was located on the deck of the steamer itself, so that without any change of position or connections it was able to run continuously, not only to drive the air into the hold and drive out the water until the steamer was floated, but also to keep her afloat until she could be towed to Quebec and safely landed in a dry dock. It ran therefore without stop or breakdown for three weeks and one day, starting at 9 A. M. on August 22.

The salvage operation as a whole was by no means so simple as might be inferred from the preceding, and much care and judgment was demanded to secure the final success. The most ticklish part of the undertaking lay in nicely adjusting the vessel's draft, because she was so caught under hold No. 2 that only a few inches of leeway was allowed in regulating her trim. An even keel until she was clear of the rocks was not to be thought of. It was necessary that she should not draw more than 6 feet 9 inches forward and 14 feet aft, lest any acuter angle should increase the grip of the rocks even at high tide. Thanks to the skillful manner in which she was handled, the Hendonhall was freed about an hour and a half before high water on a moderate spring tide. At the time of her release her engine room was purposely

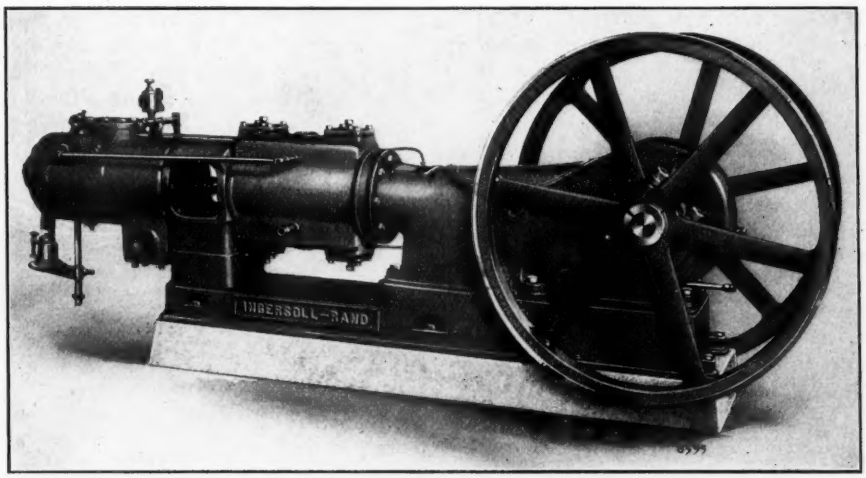


FIG. 3. OIL-ENGINE-DRIVEN AIR COMPRESSOR.

partly flooded and a quantity of water was carried also in No. 4 hold, not only to assist her trim by the stern, but to list her in order to facilitate her clearance.

The ship was thus kept afloat practically without a bottom, and was taken in that condition up the St. Lawrence to Quebec, a distance of about 250 miles. On the trip it was a simple matter to bring her to normal trim.

METAL MINING IN BOLIVIA

Bolvia has an area of 708,195 square miles, which is over twice the area of the Pacific Coast States of Washington, Oregon and California. The population is 2,268,000, LaPaz, the capital having only 82,000. It has no seacoast, being shut off from the Pacific by Peru and Chili, with Brazil north and east and Argentine and Paraguay at the south. It is also a rough country for railroad construction and operation, so that it remains to a great extent undeveloped. Its mineral wealth is shown by its recent exports under these unfavorable conditions. In the first five months of 1915 the export of ores and metals aggregated 20,894 metric tons divided as follows: tin, 17,055 tons; copper, 2,037; bismuth, 211; wolfram, 243; antimony, 1,315; silver ores; 33 tons.

This record suggests that here must be an inviting opportunity for the modern mining engineer. Our interest in this region is stirred by a personal letter from a mining engineer, Mr. F. A. Savage, who has recently come in touch with one of the active mines there. His letter gave an unusually realistic account of his voyage from New York to the Panama Canal, down the west coast of South America, and then up the western slope of the Andes until the mining region was reached at Catavi. We are compelled to omit all this, but the portion of his narrative which follows is quite in our line.

I will now attempt, he says, to give you a slight idea of the conditions that I have encountered at Llallagua (pronounced Yayagua) mine.

The mine is located three or four miles from Catavi and 1,500 feet higher. All the formation of the region is decidedly volcanic and hot springs are frequently encountered. About twenty miles distant there is an active peak which occasionally throws ashes around the mine site.

The tunnel entrance to the mine is known as Cancaniri. It penetrates the hill about 2,600 feet and then branches off into various workings of the mine. An electric railroad runs into this tunnel, and is used to convey the ore and waste from the mine. The locomotive is a General Electric, Single Phase, and has given excellent results.

The ore is brought out to a "coffing dump" and there is parted, entirely by female labor, and sacked for shipment. It is surprising to know that these women become very expert in classifying the ore, and seldom, if ever,

does the ore which they have sorted fall below 60 per cent.

The upper mine, with another tunnel, is known as "Socabon Azul." A small amount of ore is extracted through this tunnel and sorted by the women, but most of it, however, is extracted through the lower tunnel, as there is direct connection between the two.

We have at the mine three Imperial compressors, one being WB2, 24 by 13 by 16 inches, and the other two being XB type compressors, the largest of which is 18¼x10¼x10 inches. The smaller one carries no plate, and has never been stopped long enough for me to get the exact size.

Considering the fact that we must run either the big compressor or the two smaller ones—on account of lack of power—I believe you can readily appreciate the fact that we are always short of air. Our pressure varies from 30 to 50 pounds, [which of course is always too low. Ed. C. A. M.] and it is a decided wonder to me that the machines have done as good work as the present indications show.

We have working at the mine now 43 Jackhamers, BCR-430, 21 BC21 stopers, 4 B104, 3 No. 18 Leyners, 5 Bolide (Francois type) Hand Hammers, and 3 Bolide (Francois type) stopers. I must add that we are running also one No. 3 and one No. 5 Leyner Drill sharpener with this air.

The photo [unfortunately not reproducible] shows a BCR-430 (regular Jackhamer) and it is an excellent illustration of the condition in which I found most of the machines at this property. All but one stud has been broken off the valve chest and the chest is tied to the machine with blasting fuse. I have in times past seen numbers of machines of different makes which have stood a great amount of abuse, but conditions at Llallagua Mine when I arrived here were such that I cannot even yet understand how the machines have stood the work.

Any one can readily understand what would happen to a normal Jackhamer piston, for instance, if, after the special hardening process as followed at the factory, it were placed in a blacksmith fire and heated to a white heat, then allowed to cool and after being filed replaced in the machine. That has been done here and it is merely one of the conditions encountered. There are other practices which would cover practically every spare part. The greatest difficulty encountered is in the objection which prevails as to the buying of repair parts for any machine. The idea seems to be that it is cheaper to buy entire new machines than to repair those on hand, and it makes the cost of machine drilling run up like the very devil.

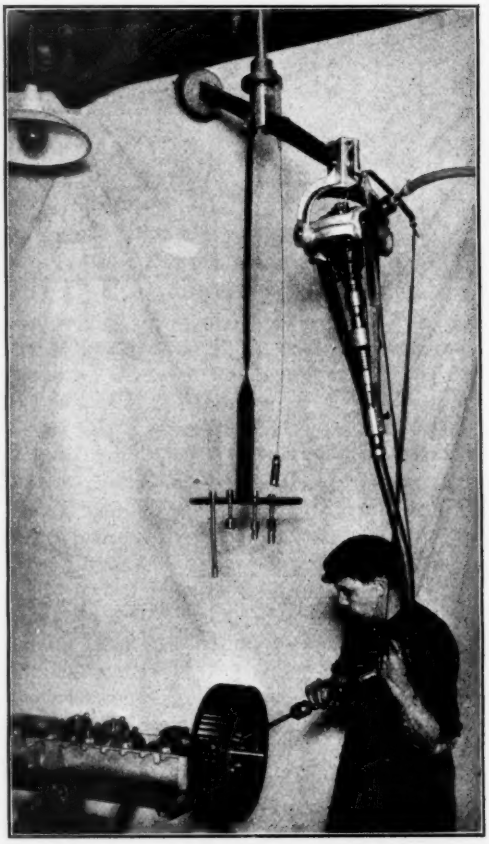


FIG. I.

TIME AND MOTION STUDIES LEAD TO PNEUMATIC TOOLS

The interesting photos here reproduced by the courtesy of Mr. Geo. D. Babcock, production manager of the H. H. Franklin Manufacturing Company, Syracuse, N. Y., show samples of the air operated labor and time saving devices employed in the manufacture of the Franklin automobile, facilitating and quickening production and reducing the cost of the output, besides lightening the work of the operators.

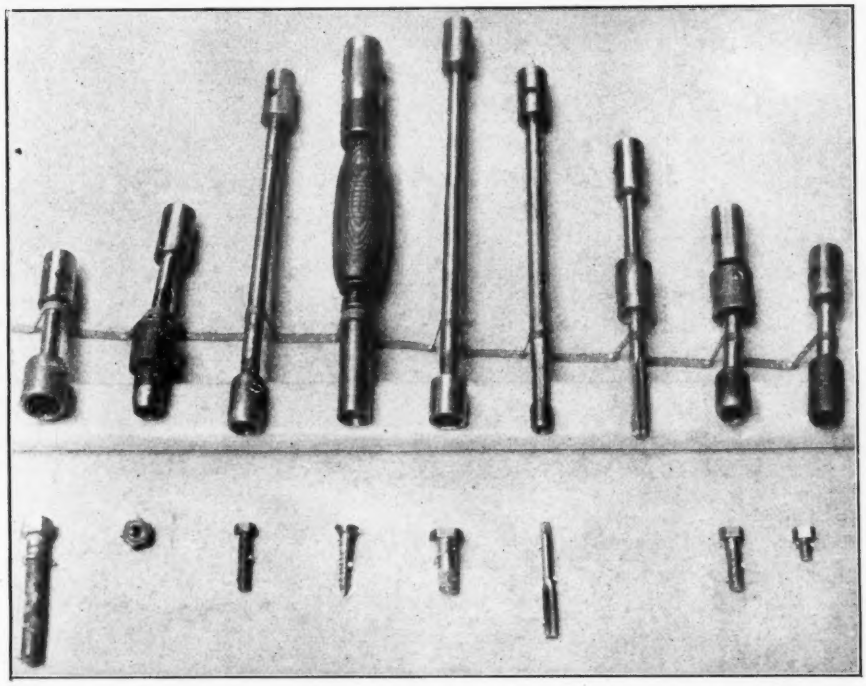


FIG. 2.

Where there many screws, nuts, studs, etc., on a machine, as is notoriously the case with every automobile, it takes in the aggregate a long time merely to tap the holes, insert and run home the screws, run on the nuts, etc., and while it is all light work human hands can only go so fast, and they tire quickly. In Fig. 1 we see just an ordinary boy doing work of this character with the aid of a pneumatic motor and it is worth while to note the elaborate provision which has been made for thus doing with quick repetition one of the simplest jobs of the shop.

The pneumatic motor overhead is mounted in a gimbal which allows it to tip freely in any direction, the gimbal being attached to the end of a lever which is weighted at the other end to balance the entire apparatus. The fork in which the lever is fulcrumed extends down from a trolley which runs on a horizontal rail. This spindle of the motor is extended below and connected to a flexible shaft which carries the special socket to fit the screw or nut to be operated on. In the spindle, before connecting with the flexible shaft, there is a friction clutch which is so adjusted that when the screw is driven home with the right tension it will

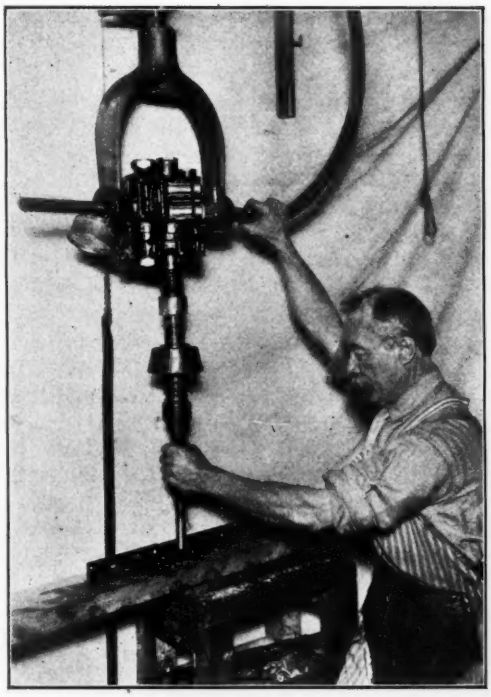


FIG. 3.

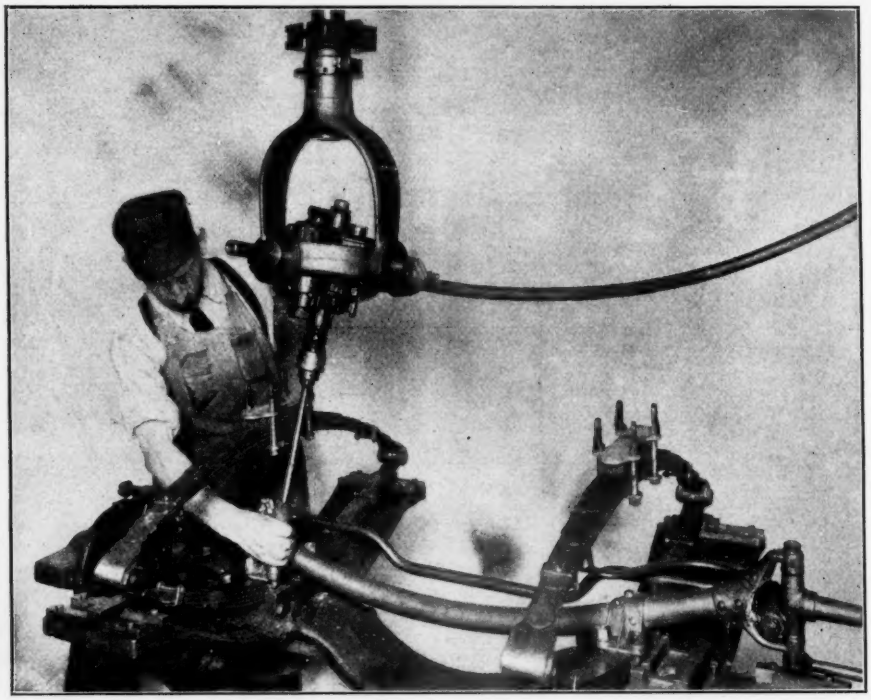


FIG. 4.

instantly allow the shaft to stop and nothing can be broken. Two light straps run up from the boy's hand to the ends of a cross lever that works the air valve. Convenient to the boy's hand is a rack with other sockets of different sizes and shapes for use as they may be required. Fig. 2, shows a variety of these sockets with the several pieces for which each is adapted. These seem to call for no special remark except perhaps No. 4, which is an ordinary wood-screw. That no time may be lost, an internally conical socket drops over the head of the screw, thereby finding the center so that the screwdriver drops into the slit immediately and drives the screw home at once. This woodscrew work is seen in operation in Fig. 3.

Fig. 4 shows the operation of driving front axle spring clip nuts, which requires no special mention. All parts in these several operations are arranged with safety stops and safety pins, the latter so that if any breakage occurs overhead the part will be stopped by a safety pin and will not drop.

Fig. 5 is a powerful compound lever device for clipping off the projecting ends of bolts.

The savings effected by some of these tools in the above establishment have been listed as follows:

1. Driving front axle spring clip nuts (Fig. 4) as compared with hand wrench 56%.

2. All engine studs, screws and nuts, 71%.

3. Rear axle tubes to rear axle gear case (no illustration) 41%.

4. Transmission studs and screws (no illustration) 68%.

5. Steel angle iron wood screws and other wood screwing on the sill 75%.

6. Bolt clipping 56%, special jaws lasting twice as long.

A LABORATORY WIND TUNNEL

By means of the "wind tunnel" of the Aëronautical Laboratory of the Massachusetts Institute of Technology experiments have been made upon a model sail to determine the true centre of pressure, the normal pressure per unit of area for a given wind velocity, and the proper angle of boom to centre line for fastest sailing over a given course.

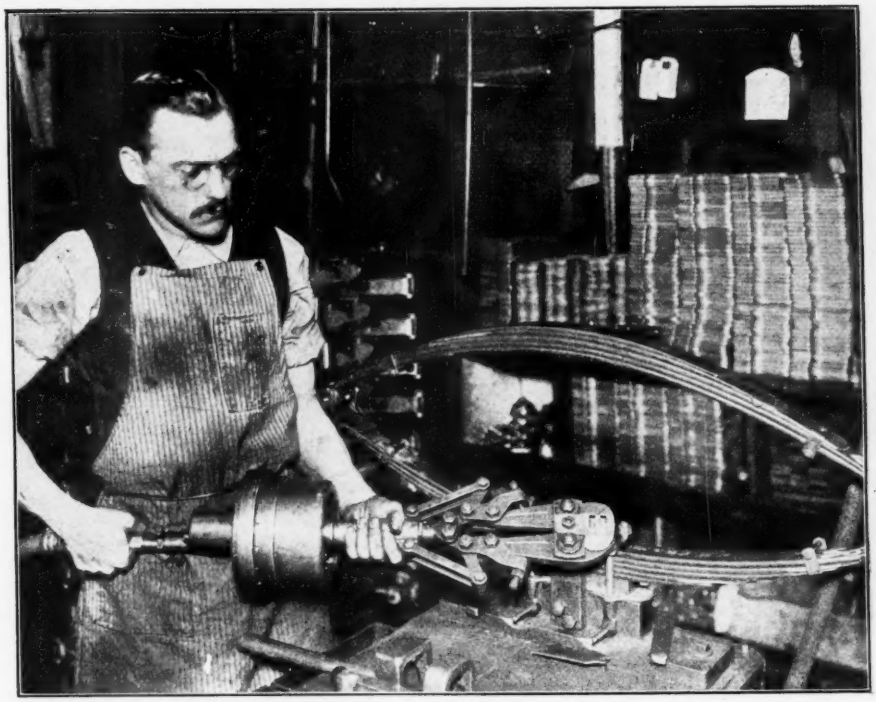


FIG. 5.

The "wind tunnel" consists essentially of a square duct, 4 feet on a side, through which a current of air is drawn at uniform velocity with a balance under it which supports the models to be tested and weighs the forces acting on them.

The experiments were carried out with a model of the mainsail of a racing yacht made to a scale of ⅜ inch to 1 foot. Among the other results of the experiments it was shown that for courses from 45 degrees to 160 degrees with the apparent wind (shown by the fly at the mast-head) the angle between the boom and the centre line of the ship for best sailing with this sail should be approximately one-half the angle between the fly at the masthead and the centre line of the ship.

FANS TO KEEP FROST FROM STORE WINDOWS

The Emerson Company recently received a letter from a central station superintendent, inquiring for an electrically-driven centrifugal blower for circulating outside air in two show windows through a series of six nozzles designed to impinge cold air against the plate glass at points approximately two feet apart for the entire length of the window, the object being to prevent the formation of frost during the winter months.

This user had, it seemed, tried the plan of boring numerous holes through the window casing at the top and bottom to admit cold air, and thus establish a circulation through the show window, but without success in preventing the formation of frost.

It has been well known for many years that the easiest way to keep frost off a show window is to take a small stationary type fan motor and run it steadily in the window, directing the breeze so that it will strike the glass and keep all the air in the show window in circulation.

The general circulation of air in a show window, whether warm air or cold air, has been proved to be sufficient to prevent the formation of frost even in extreme weather, as the fresh air which is constantly brought in contact with the inside of the glass evaporates any moisture which may be condensed on the cold glass, and in fact, almost entirely prevents such condensation.

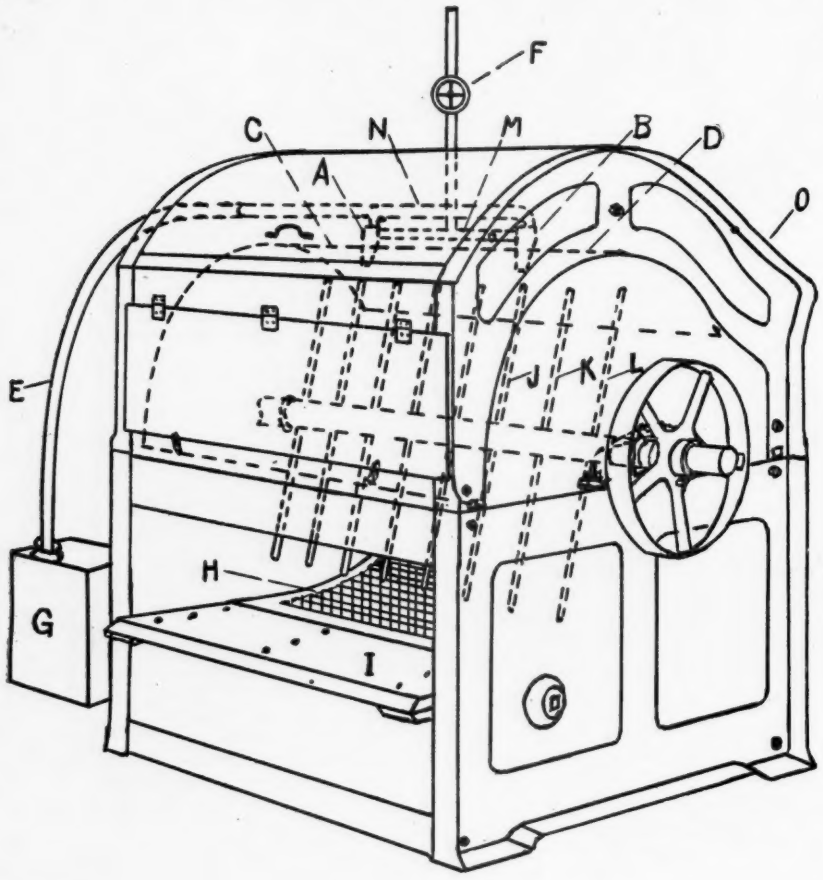


FIG. I.

COMPRESSED AIR IN MATTRESS MANUFACTURE

BY CHARLES C. PHELPS.

In the manufacture of cotton mattresses, the first step in preparing the cotton body is to pass the cotton from the bale through a machine for separating the fibres and removing solid particles of dirt or other foreign matter. Various machines are used for this purpose, which are known as willows, dusters, pickers, etc. In all of them the cotton stock is pulled apart by rapidly revolving beaters or teeth mounted on a drum, as J, K, L, etc., in Fig. 1, which represents a willow viewed from the back. This action separates many particles of dirt as well as innumerable small particles of fibre which are thrown off in the form of dust. The heavy particles fall to the bottom of the machine and are usually caught beneath bottom gratings or screens H and removed periodically or continuously. In Fig. 1 "I" is the outlet door and the feed hopper is located at "O." In the making of high grade mattresses it is considered desirable to remove as much as possible of the dust, and for this purpose an exhauster fan and condenser often form part of the equipment by means of which the cleaned cotton, after being conveyed through a duct from the outlet of the willow, is "condensed" upon a rotating cylindrical wire screen and removed in a continuous sheet from the cylinder, while the dust passes through the meshes of the condenser screen and exhauster fan and is discharged as waste material. This arrangement is not included in Fig. 1. Considerable of the

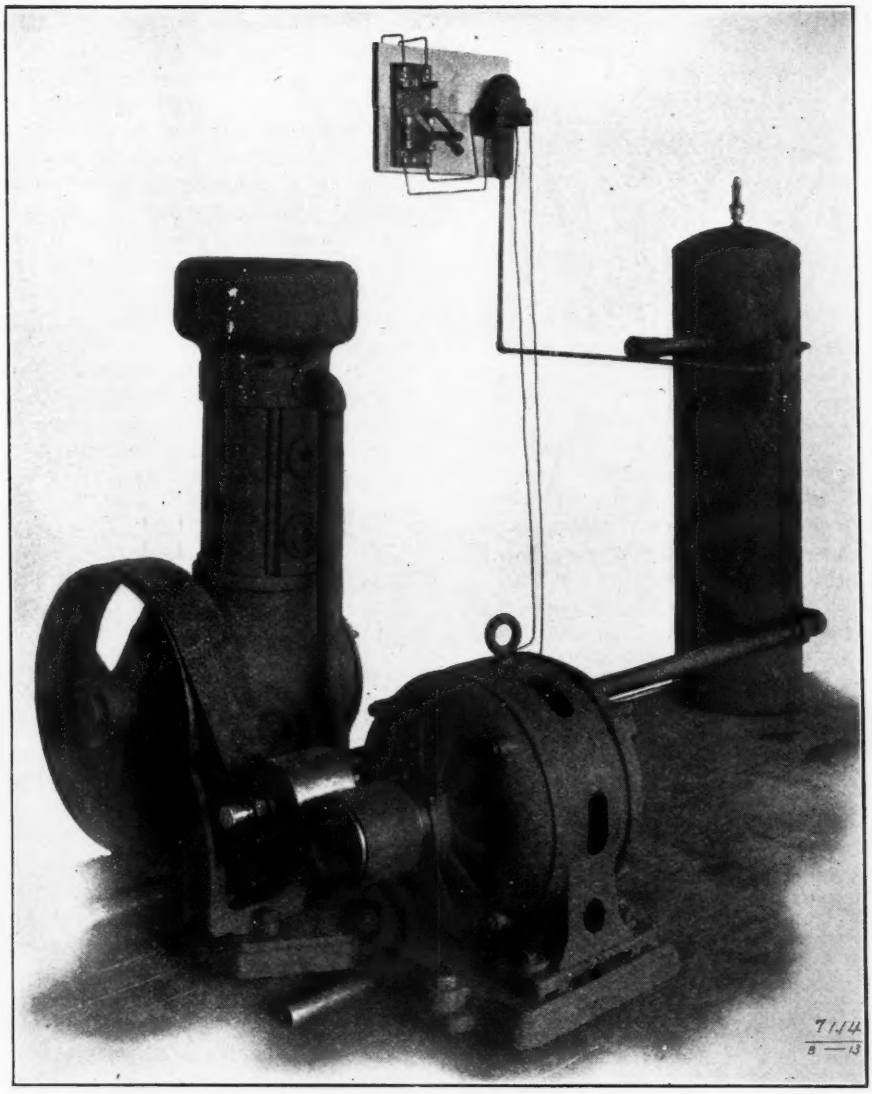


FIG. 2.

short fibre cotton is removed by this process, and as a result the weight of cleaned product will be found to be considerably less than the weight of the raw cotton.

For cheaper grades of mattresses more of the short fibre material is left in the cotton filling but heretofore this has been a source of annoyance due to the trouble with dust. This difficulty has been entirely overcome by spraying a small quantity of oil into the cotton stock while it is passing through the willow. This spraying does not interfere with the removal of the heavy particles of dirt which are thrown to the bottom of the machine; the dust, however, is completely allayed and remains in the stock instead of passing out of the machine. This spraying reduces the quantity of waste and is said to make the cotton more fluffy. At the same time, it makes the working conditions in the willow room more healthful, and reduces the fire hazard caused by the excessive dust formerly raised by the willowing operation. One spraying is sufficient for the entire process, allaying the

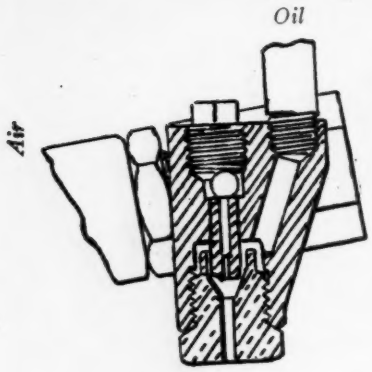


FIG. 3.

dust throughout all subsequent operations. The oil is not supplied in sufficient quantity to work through and stain the ticking covers, yet the men who sew the covers claim that mattresses are much easier to sew after applying oil to the filling. At one mattress factory which has used the oil spraying method for many months they state that they have never injured a mattress in any way by the oil treatment but consider that their product has been greatly improved thereby.

Any medium body odorless oil can be employed. A company operating mattress factories in Texas and Mexico employs a brand known locally as "Red Engine Oil" put up by the Pierce Fordyce Oil Co., which sells for about twenty cents per gallon. Five gallons of this oil is sufficient to treat thirty bales of cotton. As the average weight of cotton in a mattress is around forty pounds it is apparent that each mattress absorbs about one-tenth of a pint of oil.

Compressed air is employed for atomizing the oil. In the plants referred to above two sprays, A and B, Figure 1, are placed in the top of each willow, each spray located one quarter of the length of the willow from the end, so that the nozzle extends about one-half inch below the cylindrical screen C D, through which the fine dust and lint are ordinarily blown. Different styles of atomizing nozzles are employed. One type that has given satisfactory results is a small water spray, such as used on Jackhamer drills. This is illustrated in section in Fig. 3. The oil line, consisting of a three-eights inch pipe, enters the window through the end of the machine between the top of the screen and the cover and is connected with a five gallon can of oil by a length of rubber tubing. The half-inch air line is brought to the sprays through the top of the machine and has a valve conveniently located above the willow. The construction of the atomizing nozzle is such that the oil is lifted from the tank as well as sprayed by the air pressure. An air pressure of from 50 to 80 pounds per square inch is carried, and each spray requires about 2 cubic feet of free air per minute. Air is obtained from an "Imperial" Type XII Compressor of 3-inch stroke and 2½ inch bore, driven by a 1-½ horse power electric motor, short belted to the Compressor (Fig. 2). Air is discharged into a receiver, which equalizes the pressure.

In addition to the advantages mentioned above, the machinery is kept in a cleaner condition by using a compressed air jet periodically for blowing the dust and lint from its surfaces.

NEW METHOD FOR PURE IRON

It has been recently announced by the University of Illinois that a new method of producing pure iron, whereby a great saving can be effected in the electrical industries of the country, has been discovered by Trygve Yensen of the experimental bureau of the university. The new method consists in melting electrolytically-refined iron in a vacuum, and this reduces the impurities to a point far below that which has been reached by previous investigators. The magnetic properties of this vacuum-fused iron have proved to be as remarkable as its purity, its maximum permeability being reported to be about 20,000, or about seven times that of the sheet metal commonly used for transformer cores. The practical result of this investigation is obviously that the amount of iron required for the magnetic path in electrical machinery of all kinds can be reduced very materilly and the magnetic losses may be largely decreased. It is said that the University of Illinois has declined to permit a patent to be taken out on the process, as it is believed that the benefits from it should accrue to industry as a whole.

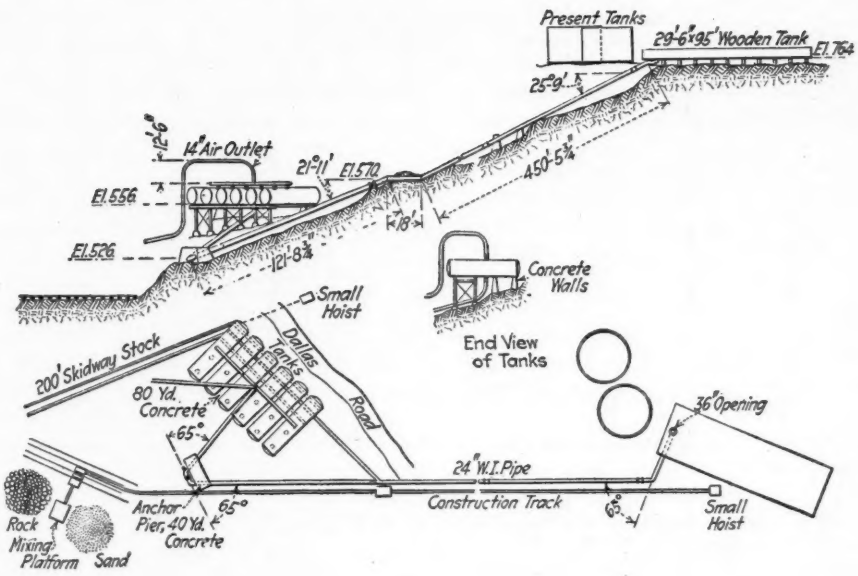


FIG. I.

COMPRESSED AIR EQUALIZING SYSTEM AT COPPER QUEEN

BY FRED M. HEIDELBERG*

Power for the Copper Queen Consolidated Mining Co., Bisbee, Ariz., was formerly generated separately at five of the company's shafts. About the middle of 1908 a central power house was built. Five 400-hp. Stirling boilers, with economizers and superheaters attached, were to furnish the steam, two 3,500-cu. ft. per min. Ingersoll-Rand compressors were to supply the air, while three 500-kw. Curtis vertical turbines were to furnish the electrical power.

The air consumption was the big variable and worked the greatest ravages on the plant. The compressors were connected directly to the air system. The governors on all compressors were controlled so as to keep the pressure about 90 lb. gage. The equipment using air consisted of three main hoists—one Sullivan, one Fraser & Chalmers and one Nordberg—several hundred air drills and many other kinds of minor hoists and air machines distributed about the different shafts. It was found that since the Gardner mine hoist was so far from the power house, it could be run more economically on air than on steam; therefore air was used, thus adding another Sullivan hoist to the air-consuming engines. More mine development made it necessary to install a 7,000-cu. ft. per min. Nordberg compressor to take care of the increased air requirements. The average consumption of air during the year 1912 was about 10,000 cu. ft. per min., while the maximum and mimimum instantaneous requirements of the compressors were 14,000 and 2,000 cu. ft. per min. respectively. The minimum would take place between shifts when no air-using machines would be working. One 3,500-cu. ft. compressor would then run at little more than half speed. The maximum was furnished when all three compressors were running at full speed.

Naturally, the maximum instantaneous supply would take place when all hoists and most of the drills were working at the same time. The demand on the air system would be so great that all the compressors would jump from about half speed to full speed. Besides the undue racing of the compressors the demand on the boilers would be strong. Also, the air pressure would drop from 90 lb. to below 65.

Such conditions mean tearing the plant to pieces. Consequently, after a thorough investigation it was decided to install an air-storage

*Box 1179, Bisbee, Ariz.

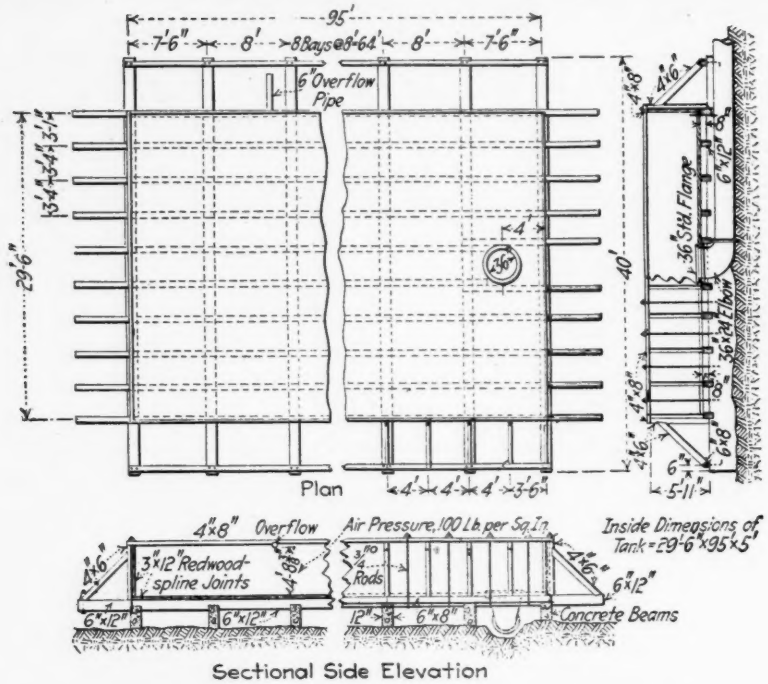


FIG. 2.

and balancing system which would store up the air when consumption was light for use when the air consumption was large, and keep the pressure nearly constant through a great part of the storage. This would allow fewer compressors in use and allow them to be run at a nearly constant speed. In essence the plant consists of a steel-tank storage for air kept at a nearly constant pressure by a hydrostatic head.

GENERAL FEATURES OF THE ARRANGEMENT.

The layout is shown in Fig. 1. The storage consists of six horizontal tanks, 9 ft. in diameter, 40 ft. long, spaced 11 ft. 6 in. centers. The volume of the six tanks is slightly over 15,000 cu. ft., and they will store approximately 115,000 cu. ft. of free air at 93 lb. gage.

The air outlet at the top of each tank is 8 in. diameter and connects to a single-piece 14-in. header with 14x8 welded tees. The water inlet at the bottom of each tank connects to an 18-in. header by means of 12x18 tees welded to the header. This 18-in. header connects with the 24-in. line of the water tank by means of a 24x18 tee. The 24-in. line is of wrought iron pipe and drops 30 ft. below the bottom of the tanks to form a U. At this U is a 24-in. gate valve. A 6-in. gate valve for draining and cleaning opens into the atmosphere at this point. From this U the pipe extends about 620 ft. to the wooden water-storage tank on top of the hill. The opening to the wooden tank is 36-in. and is connected by a 36x24 elbow.

There are five expansion joints in the pipe line, each allowing for a 2-in. expansion. Four of these expansion joints are between the U and the water tank and one between the U and the air tanks. Since one section of the long pipe is inclined to at angle of 21° 11′ and the other at an angle of 27° 11′, it would tend to slide down and close the expansion joints. Consequently an anchor pier 2x4 ft., top dimensions, extending with battered sides down to rock, was put in on the up side of each expansion joint to hold the upper section of pipe. Under each section of pipe a supporting pier 18 in. square on top was placed. At the U a large anchor pier was built. The pier was to have top dimensions of 6x21 ft. and was to extend with battered sides to rock not less than 4 ft.

Fig. 2 gives the details of the wooden water-storage tank. The dimensions are 29½x95x5 ft. The foundation consists of thirteen 12-in.-wide concrete beams spaced to make 95 ft.

These piers are built on the rock and upon them were placed ten 6x12's spaced to make 29 ft. 6 in. The sides and bottom of the tank were lined with 3x12 splined redwood. The bottom of the tank was nailed to the 6x12's, while the sides were nailed to 4x6's. Braces of 4x6 were then inclined, as shown, to hold the sides plumb. A 4x8 cap was then placed around the entire periphery of the tank. Both a water outlet and an inlet from the pump were provided.

The volume of the water tank is 2,800 cu. ft. per foot in height, which is slightly over one-fifth the volume of the air tanks. The total drop in head equals the drop in the water tank plus the rise in the air tank. The rise in the tanks varies for the same volume of water. At any rate one foot drop in head in the water tank displaces approximately 21,000 cu. ft. of free air at 93 lb. gage. This little example illustrates the delicacy of the system.

The water tank provides a large quantity of water with a small drop in head until the tank is empty. If there is just enough water in the system to bring the water to equilibrium when the air tanks are just full of water, the level of the water in the pipe will be about 108 ft. from the U, measured along the pipe. It is the volume from the bottom of the water tank to this point of equilibrium in the pipe that will produce the greatest drop in air pressure—that is, to zero gage. The length of pipe from this point of equilibrium to the bottom of the water tank is 512.2 ft., representing a volume of 1,630 cu. ft., approximately one-ninth the volume of the air tanks. This is a small quantity of air. It will be seen, therefore, that at no time should more water be put into the system than will just fill the air tanks at atmospheric pressure with the water at equilibrium.

The additional head of 30 ft. from the bottom of the air tanks to the U serves as a safety precaution. The air will just go around this point when the air pressure is between 103 and 105 lb. On a test at 103 lb. the system worked. When the pressure was raised to 105 lb. the air went around the bend and forced the column of water up with such force that part of the water-storage tank was wrecked.

The air tanks are supported at four places. The two back supports consist of concrete walls running under each tank. The two front supports are channel columns with channel struts between. The columns are directly under the tanks and were designed to take a load of 55,000 lb. each. Each tank rests in four cast-iron saddles, one over each support. Although the struts have no load to carry, they were designed to hold an empty tank at the center of the span, since the empty tank would be rolled over the beam in that manner while erecting. The curved air-delivery pipe is carried up 12 ft. 6 in. above the 14-in. header of the tanks to insure no water getting into the air system.

The distributing lines were located about as follows: In the power house the air discharge

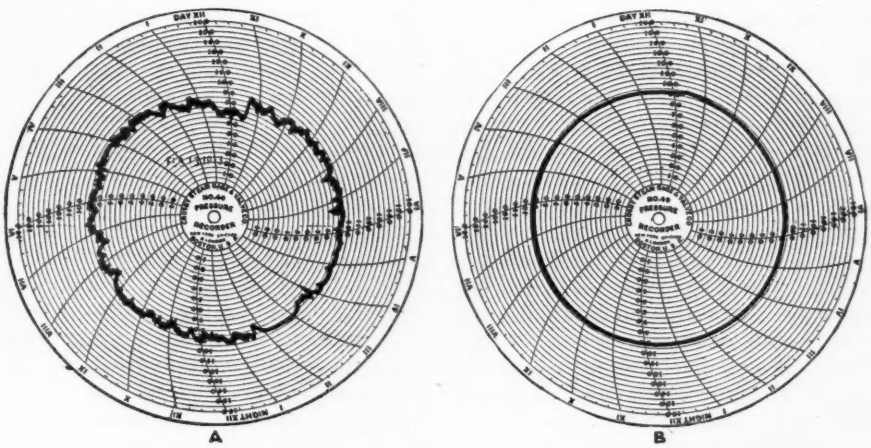


FIG. 3.

of all the compressors connected to a drum 4 ft. diameter and 80 ft. long. A 14-in. pipe-line connects this drum with a smaller drain drum just outside of the power house. Two lines lead from this drain drum—one a 14-in. line connected to the balancing system several thousand feet away; the other, a 10-in. line, leads over to the Gardner shaft and supplies air to all the mines in the northern part of the camp. An 8-in. line connects to the 14-in. line near the balancing system, to furnish air to the Lowell shaft. Drain drums were provided wherever there was a dip in the pipe lines.

In order that the right amount of water should be got in the reservoir, a set of gage-glasses were connected to one tank of the battery so that the height of water in the air tanks could be ascertained. By closing the gate valve the water in the storage tank could be kept from varying until enough new water could be added to bring the quantity to the required amount. Outside of keeping the required amount of water in the tank, the system gives no trouble. Its operation is automatic, and the pressure rarely varies over three pounds.

By way of comparison, two pressure charts are shown in Fig. 3. Chart A is an average one before the balancing system was installed and shows the great variations in pressure in the air-supply system. It will be noted that in one place the pressure dropped and it was more than an hour before it could be brought up again. Chart B, on the other hand, was taken after the system was installed and shows very little variation in pressure during a 24-hr. period.—*Eng. and Min. Journal.*

HOW WAR SCATTERS THE METALS

Specifications for Russian 3-inch shells call for a loading of 258 to 260 half-inch bullets, consisting of 4 parts lead and one of antimony. This requires practically 4.908 lb. lead and 1.217 lb. antimony per shell. In addition, fine stibnite mixed with magnesium powder is used to produce the smoke that enables an observer to register the point at which the shrapnel bursts. This calls for 0.0238 lb. stibnite and 0.02322 lb. magnesium per shell. British 3.3 inch shrapnel uses even more lead, the total weight of the bullets being 7.92 lb. and the composition 7 parts lead to one of antimony. This shell also requires 4.04 lb. copper and 1.87 lb. spelter.

EXPLOSIVES IN ENGINEERING

BY CHARLES E. MUNROE.*

Although gunpowder is recorded as having been used as a propellant at the siege of Boza in 1323, its first appearance in military engineering operations was at the siege of Merat in 1397, where it was used for springing mines. In 1585 it had come to be used in marine devices, for in that year a bridge in Antwerp was destroyed by a floating torpedo. The first reputed application of this agent to peaceful pursuits is attributed to Martin Weigold at Freiberg, Saxony, in 1613.

INVENTION OF THE HIGH EXPLOSIVES.

For over two centuries gunpowder remained the only available blasting agent, but in 1845 Schoenbein discovered gun cotton, in 1846 Sobrero discovered nitroglycerine, in 1866 Nobel invented dynamite and a new era in explosives for engineering uses began. Guttmann dates the application of these new sources of energy to blasting as 1854, but without citing person, substance, or place. In the early days of blasting the charge in the bore hole was ignited through the stemming by spills or squibs, consisting of straws, quills or rush tubes filled with fine powder. In 1831 William Bickford invented the running fuse in use to-day wherein a thin, continuous core of powder, along which the fire might slowly travel at uniform and determined rate, was enclosed in a jute tube. In 1867 Nobel introduced detonators.

FIRING BY ELECTRICITY.

To-day the preferred method of firing blasts is by electricity; therefore Americans should be interested to know that history states that Franklin, in his Letters on Electricity (June 29, 1751), was the first to suggest the employment of frictional (or static) electricity for the ignition of gun-powder, and that in 1831, Moses Shaw of New York, made the first application of this method to the firing of mines. Meeting with practical difficulties in putting his invention into industrial operation Shaw, on June 1, 1831, appealed to Dr. Robert Hare of the University of Pennsylvania for advice and assistance, and the latter applied his famous deflagrator or vol-

*From a paper before sections of the American Society of Mechanical Engineers, Providence, R. I., Dec. 18, 1915.

taic battery and a wire bridge to this use with such complete success that, though the generators for the electric current have been altered in form and character, and the detonators in details, the method devised by Dr. Hare is the method which is to-day in universal use throughout the world for the firing of blasts, mines, or torpedoes by electricity. This method was demonstrated for use in warfare when in 1843 Samuel Colt blew up a brig under full sail in the Potomac from Alexandria, which was 5 miles distant from the brig, though in 1839 Sir Charles Pasley had removed the wreck of the Royal George at Spithead by the use of low tension fuses.

FLOOD ROCK.

The blowing up of Flood Rock in Hell Gate, in New York city, was successfully accomplished October 10, 1885. Flood Rock had a superficial area of nine acres, about 250 sq. ft. of which was above water. The rock consisted of horn-blende gneiss, with intersecting cross-veins. A sea-wall 7 ft. high was built around the island, and two shafts were sunk, one 67 and the other 40 ft. deep. The main shaft was used for removing the excavated rock in blasting out the headings. The smaller shaft was used for the tubes conveying the compressed air which drove the drills. The first series of headings branched out from the main shaft at a depth of 40 ft., and from the bottom of the shaft another series diverged directly under those above. The headings branched at right angles every 20 ft. and were 60 in number in each tier. The double system of headings was employed to gain a sufficient depth after the explosion without the necessity of dredging out to the extent that was found necessary at Hallet's Point. The total length of tunneling was about four miles, consisting of 24 galleries running north and south and 46 running east and west. The longest of these was 1,200 ft. in length, 6 ft. wide and 10 ft. high. There was a thickness of from 10 to 25 ft. between the roof of the top tier of galleries and the water. There were 467 pillars, 15 ft. square, left to support the roof. The whole rock was honeycombed with tunnels, about 80,000 cu. ft. of rock having been removed.

There were drilled in the pillars and roof 13,286 chambers for holding the cartridges, each chamber being 3 in. in diameter and about 9 ft. deep. These chambers were filled with rackarock cartridges, of which there were about 47,000 used, each being 2½ in. in diameter and 2 ft. in length, and containing about 6 lb. of the explosive. In addition to the rackarock cartridges, several hundred ordinary dynamite cartridges were used, to which the wires leading to the firing batteries were attached. The shock resulting from the explosion of these dynamite cartridges caused the explosion of the rackarock. Upwards of 285,000 lb. of explosives were used in the charge.

The wiring in the mine was divided into 36 circuits, the batteries attached to these circuits being stowed in a tool-house on the rock. The wire of the primary circuit which actuated the electro-magnet that closed the secondary circuits was led across to the Astoria shore on the morning of the explosion. The firing key was about 1200 ft. from the mine.

Two siphons, one 12 in. in diameter and the other 3 in., were set at work at 10 a. m., October 9, flooding the mine, and they completed their work early the following day. The first effect of the explosion was to produce a rumbling noise, and then to project a mass of water over an area of about 1200 sq. ft. to a height of about 150 ft. Masses of rock rose in the midst of this water to a height of from 40 to 50 ft. The explosion lasted about 30 seconds. As the water fell a dense cloud of yellowish smoke arose and floated over the Astoria shore.

After the explosion the rock appeared undisturbed, though on close examination it was found to be somewhat fissured. However, it slowly settled, and by October 13th the entire rock was below water. It was not intended that the rock should be broken very fine, since with the appliances at hand pieces of from ten to fifteen tons in weight could be most economically handled. The operation covered nine years, and cost upwards of $1,000,000.

EFFICIENCY IN THE USE OF EXPLOSIVES.

The following was published by the present writer in 1900, in the Popular Science Monthly:

There is a widespread misapprehension in regard to the devastating effect of these high explosives, for when unconfined the effect even of large charges of them upon structures is comparatively slight. At the Naval Ordnance Proving Ground, so long ago as 1884, repeated charges of dynamite, varying from five to 100

lb. in weight, were detonated on the face of a vertical target consisting of eleven 1-in. wrought-iron plates bolted to a 20 in. oak backing, until 440 lb. of dynamite had been so detonated in contact with it, and yet the target remained practically uninjured; while at Braamfontein the accidental explosion of 55 tons of blasting gelatin, which was stored in railway vans, excavated but 30,000 tons of soft earth. This last may seem a terrible effect, but the amount of explosive involved was enormous and the material one of the most energetic that we possess, while if we compare it with the action of explosives when confined, its effect becomes quite moderate.

At Fort Lee, on the Hudson, but two tons of dynamite placed in a chamber in the rock and tamped brought down 100,000 tons of the rock; at Lamberis, Wales, 2½ tons of gelatin dynamite similarly placed threw out 180,000 tons of rock; and at the Talcen Mawr, in Wales, seven tons of gunpowder, placed in two chambers in the rock, dislodged from 125,000 to 200,000 tons of rock. We might cite many such examples, but on comparing these we find that the gunpowder confined in the interior at the Talcen Mawr was over forty-two times as efficient as the explosive gelatin on the surface at Braamfontein, while the dynamite at Fort Lee was over ninety times as destructive.

These views have received but little consideration from officials in this country and our Government has gone on spending money in the testing and use of devices which were certain to prove ineffective. However, I confidently point to Liege, to Namur, to Antwerp and to the effects of a multitude of perforating high explosive shells used in the present war in confirmation of the principles I developed.

Shortly prior to 1898, and while he was Chief of Bureau of Ordnance, U. S. N., I was asked by Captain Sampson to assist in the tests of armor piercing projectiles then being conducted at Indian Head by Comdr. Couden by securing a high explosive charge for them. This was done and after proving an excellent degree of fragmentation in the fragmentation pit a shell containing 8.25 lb. of the explosive was fired through 14.5 in. of the Harveyized armor of the U. S. S. Kentucky and exploded on the inner side. So far as records go this had then never been approached.

When Admiral Sampson took command of the fleet he wrote me asking my assistance in securing high explosive charges for the armor piercing projectiles of his fleet. I delivered his message and used my best endeavor, but the material called for was not sent and it remained for the Japanese to be the first to demonstrate in practice the soundness of these principles.

This study was continued and extended to bore-holes in blasting operations by my pupils, Clarence Hall and W. O. Snelling, and their results and conclusions were published in 1912 as Technical Paper No. 17 of the Bureau of Mines under the title "The effect of stemming on the efficiency of explosives." It was naturally of interest to learn that a manager of a considerable mine reported a saving of $50,000 in his explosives' account in a single year by following the methods for using stemming taught by this research.

More recently Edgar A. Collins has stated in Min. Sci. Press, Vol. 110, p. 790, 1915, that he has found in practice where 30 per cent. ammonia gelatin was being used in a given mine a saving of 25 per cent. in quantity of the explosive was effected by increasing the depth of the tamped stemming above the charge, and that as a consequence the amount of explosives issued to the miners had been cut to from 10 to 20 per cent. of that formerly issued.

POISONOUS GASES.

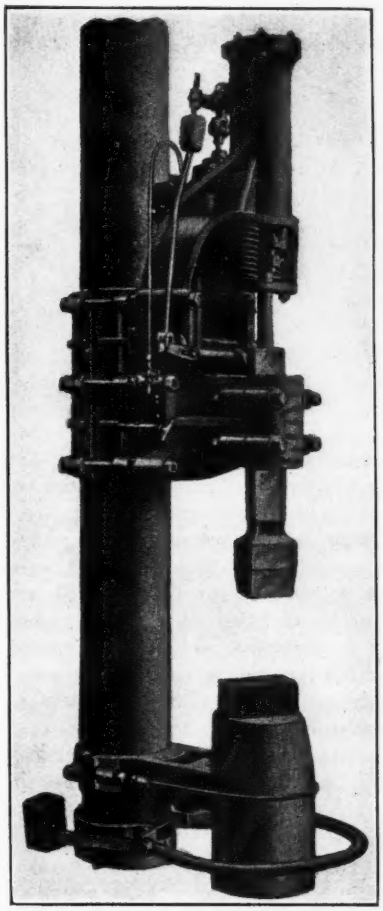
It should always be remembered that the gases produced by explosives in exploding have other properties than that of yielding larger volumes than the solids from which they are produced, for some of them are poisonous. The kind of gases produced differs with the kind of explosives used and the way in which it is used. Nitric esters and nitro-substitution compounds and the mixtures, such as dynamite, made from them, may yield poisonous nitrogen oxides and cyanogen, and poisonous and inflammable hydrogen sulphide and carbon monoxide. But if the explosive be properly compounded, well confined, and fully detonated, these harmful gases will not be produced, for the gaseous products will then be largely composed of water and carbon dioxide; and though carbon dioxide may cause unconsciousness and even death, it

does so only when it forms a large proportion of the atmosphere. Blasting powder and gunpowder-like mixtures give off poisonous and inflammable hydrogen sulphide and carbon monoxide under all conditions of explosion.

The production of inflammable gaseous products underground, especially in coal mines and bitumen mines, is most hazardous. The production of poisonous gases, either below ground or on the surface, is a source of danger, and if such gases are formed they should be removed by ventilation before anyone is allowed to approach the working place. Neglect of this precaution led to the death of 7 persons and the rendering of 40 others unconscious from gas poisoning following the firing of 21,000 lb. of blasting gunpowder at the Crarae quarry, Loch Fyne, Scotland, on September 25, 1886. The quarry was situated in a basin in a hill with sides rising 25 to 250 ft. and was approached by a narrow gorge. The blast was fired in the presence of an audience of over 1,000 persons and at least half an hour after the blast 120 got into the quarry to observe the effect, and within five to six minutes after entrance they began to fall, overcome by the poisonous powder gases entangled in the crevices of the rock that had been thrown down.

In a large engineering project in the West nine men lost their lives as a result of the poisonous gases produced on the detonation of 40 per cent strength gelatin dynamite in a long tunnel. After igniting the blast the men retired about 500 ft. to wait for the smoke to clear, and while they were waiting the smoke drifted slowly over them, and then, owing to some change in the air current, drifted slowly back again. The men felt the usual symptoms of carbon monoxide poisoning—slight choking, nausea, profuse perspiration, and headache—but they all revived upon reaching the open air about an hour and a half after the blast had been fired. Within a short time, however, the men began to cough and spit bloody mucus and show other symptoms of nitrogen peroxide poisoning. In less than three days 9 out of the 13 men who had been in the tunnel and exposed to the fumes had died; the other four, as well as those who went in with the motor to bring out the men, were ill for days and even months after the catastrophe.

It was soon after the accident mentioned above that special studies of the noxious gases evolved on the detonation or combustion of different explosives were undertaken by the Bureau of Mines to determine whether improvements could be made in the composition of explosives with a view to increasing safety in mining.



IMPROVED POST HAMMER

The halftone shows a post hammer recently brought out by the Q. M. S. Company, 2059 Elston Avenue, Chicago, which speaks for itself as to its general handiness and adaptability. It originated in connection with tool forging, but is good for a wide variety of work, and while it may be operated with either steam or air it is, as is the general experience, more lively and satisfactory with the latter and, on account of the intermittent service, the power expense is quite negligible.

The action of the hammer is entirely controlled by the treadle. If it is brought down to the limit the heaviest blow results, like that of a drop hammer, and the force will be proportionally less accordingly as the treadle is less depressed. With a shop supply of air maintained for general use the hammer is always fully ready for work.

COMPRESSED AIR IN CONSTRUCTION AND REPAIR WORK.

BY CHARLES C. PHELPS

In connection with construction and repair work both above and under ground there are many operations that can be performed much more economically and expeditiously with the assistance of compressed air than by any other known means.

PORTABLE COMPRESSORS.

In many instances it might not be advisable to construct a stationary compressor plant or to pipe air from an existing plant located at a distance, owing to the temporary character of the work. The average up-to-date coal-mining property is equipped with an electric transmission system, and under these circumstances one of the most convenient means of obtaining compressed air for use in construction and repair work is by employing electric motor-driven portable compressors. Truly successful apparatus of this type is of comparatively recent development, and it is the intention to discuss in this article only the various types of electrically driven outfits and their uses. It should be borne in mind, however, that corresponding machines driven by other prime movers, such as gasoline, oil or steam engines, are sometimes better adapted to existing conditions and, as a matter of fact, are in extensive employment.

JACKHAMERS.

Construction that must be prosecuted at one time or another outside of the coal mine usually involves rock cuts and the removal of boulders in connection with grading for tracks or roads, digging trenches and pits, removing old concrete and masonry construction and the like. For these purposes Jackhamers, operated by compressed air, are highly economical, drilling from 100 to 200 ft. of hole per shift, whereas one-tenth of this footage could not be obtained in all probability in the same time by hand.

PNEUMATIC RAMMERS.

In building concrete foundations, culverts, bridges, dams, sluices, buildings, etc., pneumatic concrete rammers are often used to advantage. A Belgian engineer who made a study of this subject found that the number of blows struck played a far more important part in compacting the concrete than the force of the blow. It follows that the pneumatic rammer, which strikes approximately 600 light blows per minute, is ideal in comparison with hand ramming in which the maximum speed obtained is 50 or 60 blows per minute. This conclusion is verified by a test made with small cubes in which 60 blows left the concrete with a resistance of 2,844½ lb. per sq. in., 40 blows with 2,460¾ lb. and 20 blows with 1,538 lb. A similar test with hand ramming gave a resistance of only 939 lb. per sq. in. The hand rammer used weighed 33 lb. and was permitted to fall from a height of 20 in.

It is apparent that by obtaining a stronger product by tamping, a lighter structure will often serve the purpose, saving considerably in cost of materials and workmanship. Pneumatic tampers of a different type are being adopted extensively for tamping railroad ballast.

PNEUMATIC DRILLS

In the construction of steel or wooden bridges or trestles, laying tracks and erecting steel or wooden structures of various kinds, pneumatic tools are invaluable. Pneumatic drills, are used for drilling metal, boring wood, reaming, tapping, operating jacks, cranes, hoists and grinding wheels and small circular saws. They are also of great advantage for running in lag screws and tightening nuts. In one case a gang of seven men put up from 80 to 100 hangers in 9 hr., each supported by two ¾-in. lag screws. The holes were bored with pneumatic augers using ⅝-in. bits, later driving the screws home by means of the same motors used with extension sockets. This is at least double the work that could be performed under similar conditions by using augers and wrenches operated by hand.

PNEUMATIC HAMMERS

There is no comparison to be made between pneumatic riveting hammers and hand methods for heading rivets. Compressed air is also convenient for blowing rivet-heating forges.

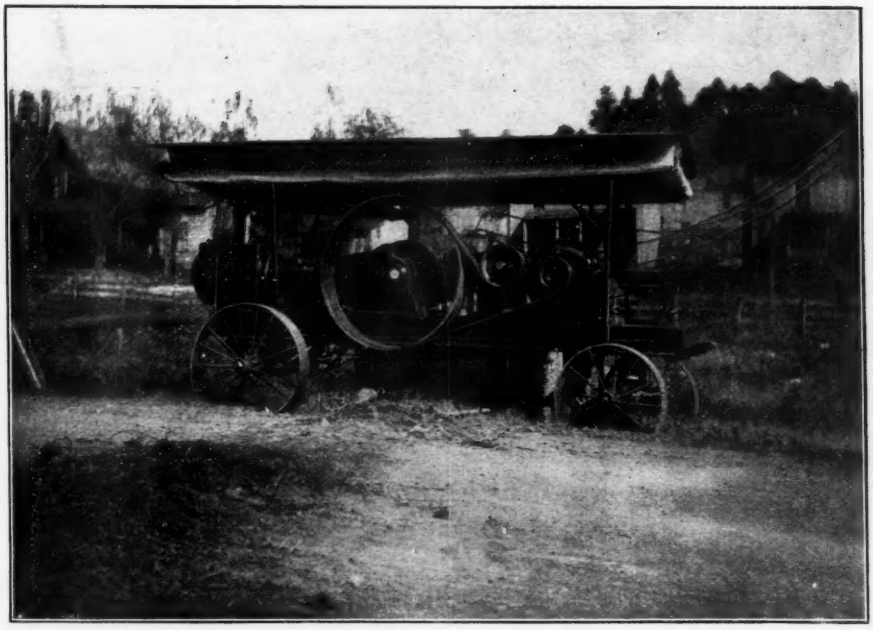


FIG. I. PORTABLE ELECTRIC DRIVEN AIR COMPRESSOR.

Riveters can be fitted with a handy rivet "busting" attachment and have been adapted to driving spikes. In one case they were used for driving 9-in. spikes at the remarkable rate of 5 sec. each. On the same job a number of ⅞-in. bolts 38 in. long were each driven by compressed air in 1 min. as against 18 min. by hand.

Pneumatic chipping hammers are invaluable for trimming, cutting and calking metal and may be fitted with a special chisel for such work as peeling the bark from logs in preparing ties or props. This last is a new application of this tool which is capable of great savings. It is said that the most expert tie peeler is capable of peeling by hand an average of 100 ties per day of 10 hr., but the average output is nearer 50 ties per day. Experiments have shown that an inexperienced laborer has no difficulty in thoroughly peeling from 150 to 200 ties per day with a special air-operated tool. These tools do not consume much air, but even with this expense added, there is a large saving over the old method.

In connection with repair work the opportunities for using pneumatic appliances are almost without number, for it is in this class of work particularly that it is often desirable to take the tool to the part to be repaired instead of taking the part to the shop. The greatest savings effected with portable pneumatic tools often pertain to the avoidance of costly delays incident to some minor part giving way and affecting the operation of important machinery.

In addition to the applications outlined, pneumatic drills are used for grinding and reseating valves, for reboring cylinders and for operating large valves and small machines. Chipping hammers are used for quickly cutting out sections of pipes and sheet-metal work and for scaling rust and paint from metal surfaces. The cement gun, the sand-blast machine, pneumatic paint and whitewash spraying machines, pneumatic displacement pumps and air-operated reciprocating pumps are other devices of the greatest value in repair and construction work.

MISCELLANEOUS USES OF AIR

Many of the appliances mentioned also find everyday application about the shop and power plant. A few of these applications may be enumerated as follows: Setting locomotive valves; expanding boiler tubes and flues; cleaning scale from boiler tubes with the aid of pneumatic drill motors; beading tubes and

calking sheet metal with chipping hammers; drilling anchor-bolt holes in concrete machinery foundations; blowing out the air spaces of electric motors, the flues of boilers and other inaccessible places by means of an air jet. Compressed air is also commonly used for testing the tightness of pipe lines. Air from a stationary compressor is not available in some of the smaller plants, and in such cases a portable unit might be used to advantage.

VARIOUS TYPES OF PORTABLE COMPRESSORS.

Having defined the field of the portable compressor in general, the various types will now be described briefly. The mine car compressor is the most suitable type for underground operations. During the past few months it has been adopted extensively for operating hand drills, mounted cutting machines, punchers, pneumatic tools, etc. After a brief try-out that demonstrated beyond doubt their economy, one Pennsylvania coal mine purchased 14 of these outfits, and many other mines in various parts of the country are starting to use them.

This equipment is a self-contained, self-lubricating, electrically operated unit, totally inclosed as a protection against the entry of dirt to the working parts. It can be started up by the miner and will run without further attention while he is drilling the coal or rock, excepting occasional replenishment of water in the reservoir cooling jacket surrounding the compressor cylinder. It may be quickly and easily moved over the regular mine tracks to any part of a mine and can be set up and connected with the regular mine power wires in a short space of time. This type of compressor is made in capacities ranging from 78 to 415 cu.ft. of free air per minute.

The mine car compressor is equally suitable for use above ground provided the work is situated within a few hundred feet of the tracks over which it runs. Fig. 1 illustrates a type that is perhaps better suited for general conditions above ground, as it can be transported by horse or other power to almost any location. The entire outfit is mounted on a covered truck. It is built in various capacities ranging up to 464 cu. ft. of free air per minute.

The cost for power of such an equipment is less than would be expected. Consider the case of a motor-driven compressor of 145 cu. ft. displacement. This would require a motor with a horsepower input of about 25 for 70 lb. air pressure. Three cents per electrical horsepower per hour is undoubtedly a liberal allowance for power in coal-mining regions. Interest, depreciation and repairs figured at 25 per cent. of the initial investment of such an equipment would amount to about $200 per year—a liberal estimate. Based on 300 working days per year, one shift per day, this figure would reduce to about 67c per shift.

Supposing the work under consideration is the digging of a wide ditch through rock, employing two hand drills for an 8-hr. shift, the cost would figure about as follows per shift:

Operator	$4.00
Two-drill runners at $2.50	5.00
Lubricating oil	.50
Power for air, 25 hp., 8 hrs. 3c per hp. hr.	6.00
Interest, depreciation and repairs	.67
Total per 8 hr. shift	$16.17

No reduction is made in power charge for unloaded periods, which would undoubtedly reduce this charge considerably.

The footage accomplished with a Jackhamer drill is usually between 100 and 200 ft. of hole per day, depending upon conditions. We shall assume 150 ft. as an average accomplishment. The two machines would therefore drill 300 ft. per day. Thus the cost per foot of hole drilled would amount to $0.0539.

Under similar conditions the two drillers could put in by hand not over 20 or 30 ft. of hole per shift, employing the "single-jack" method. Assuming the same rate of wages and an average accomplishment by hand of 25 ft. per 8-hr. shift, the labor cost would be $5 for the two men, and the cost per foot of hole 20c.; in other words, machine drilling with the portable compressor, including all charges, would result in a saving of $0.1461 per ft.; that is, a saving of about 75 per cent. The cost of sharpening steel has not been included in the foregoing estimate as it would be about the same per foot in each case.

Fig. 2 shows a convenient type of portable compressor for use in shops, power plants and other places where a small amount of compressed air is required. The compressor proper is an air-cooled Imperial type XII vertical machine having a capacity of 6-cu. ft. displacement. A type of short belt drive similar

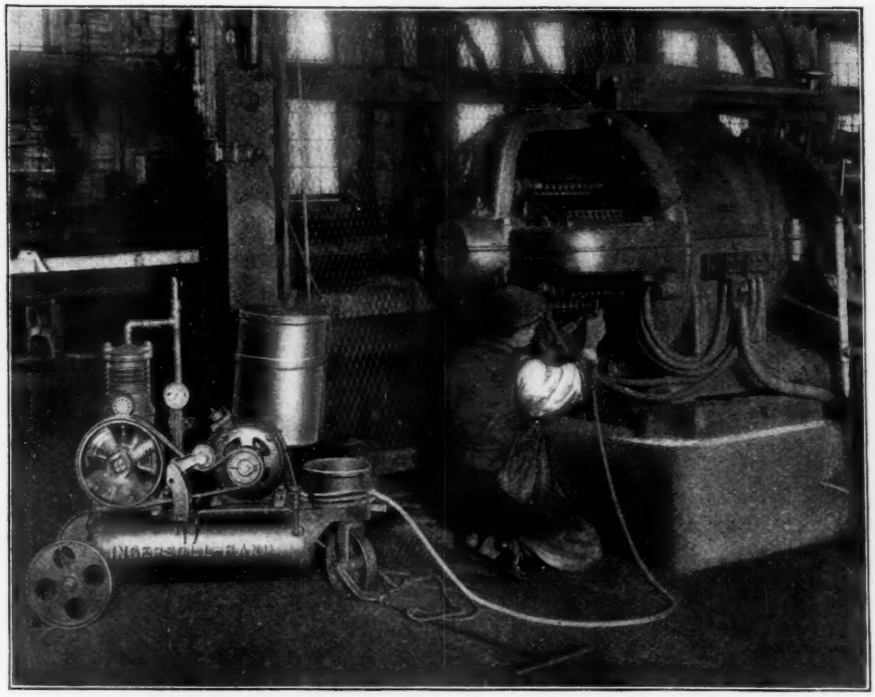


FIG. 2. HANDY PORTABLE SHOP COMPRESSOR.

to that used on larger machines is used to connect motor and compressor. The air receiver forms the body of the truck, and on it are mounted compressor, motor and all accessories, including a 20-ft. coil of air hose, plug and switch, wire, etc.—*Coal Age.*

ACTION OF GASOLINE VAPOR IN AIR

BY GEORGE A. BURREL.

Gasoline vapor mingles with air in the same manner that water vapor does. At any particular temperature a definite proportion of water vapor will be found in the atmosphere if it has become completely saturated, a condition that seldom exists. Usually a limited supply of water has been given off into the air, and the atmosphere is spoken of as having a certain relative humidity, meaning that the saturation is incomplete or that more water vapor could exist in the air were a source of moisture available. In a similar manner gasoline vapor mixes with air. The amount of vapor carried will depend on the temperature of the air and the readiness with which the vapor can be obtained.

If gasoline is exposed to the air of a room and for a long enough time, the air will contain at a certain temperature a fixed proportion of gasoline vapor, differing for different grades of gasoline, that can not be exceeded. The author has worked out the values for four different grades. The results for a temperature of 17.5° C. (63.5° F.) are shown in the following table:

Proportions of different grades of gasoline vapor that air will carry at a temperature of 17.5° C.

Grade of gasoline	Proportion of gasoline vapor (per cent).
Cleaner's naphtha	5.0
64° B. gasoline	11.0
69° B. gasoline	15.0
73° B. gasoline	28.0

It will be noticed that air will hold almost six times as much vapor from the lighter gas-

oline as from the heavier cleaner's naphtha. If the lighter and better grades of gasoline are heated, their vapors, when a light is applied, also flash and burn at lower temperatures than do the heavier grades. This difference does not mean that some gasoline is a dangerous inflammable liquid and some is not. All grades are classed as highly inflammable and dangerous liquids.

COMPARISON OF INFLAMMABILITY OF GASOLINE AND OF GASOLINE VAPOR.

If one takes the cover off a full pail of tightly inclosed gasoline and applies a match to the surface, the gasoline will flare up and burn as long as the gasoline lasts. On the other hand, if one puts a few drops of gasoline in a small tightly inclosed pail, waits a few minutes, and then introduces a flame or an electrical spark a violent explosion will most likely result. In the first case the vapor burns as fast as it comes from the gasoline, and mixes with the oxygen of the air. In the second case the oil vaporizes in the pail and mixes uniformly with the air therein to form an explosive mixture and upon ignition explodes. Consequently, when one hears of a disastrous gasoline explosion one may be sure that the explosion resulted from the mixing of the vapor from the gasoline with air in the proportions necessary to form an explosive mixture.

One gallon of gasoline when entirely vaporized produces about 32 cubic feet of vapor. If a lighted match could be applied to pure gasoline vapor in the absence of air no fire or explosion would result. Gasoline, liquid or vapor, like any other combustible material, needs the oxygen of the air in order to burn.

EXPLOSIVE RANGE OF MIXTURES OF GASOLINE VAPOR AND AIR.

It is fortunate that gasoline vapor, like other gases and vapors, needs a certain proportion of air before an explosion can take place. The author found that in 100 parts by volume of air and gasoline, an explosion will not take place if there is less than 1.4 parts of gasoline vapor or more than 6 parts. In other words, the explosive range is between 1.4 and about 6 per cent. of vapor. Flashes of flame will appear in mixtures containing considerably smaller or larger proportions of vapor, and considerable pressure will be developed, but propagation through the mixture will not take place.

Although the range of explosibility mentioned is narrow as compared to that of many other mixtures of combustible gases and air, yet the proportion of gasoline vapor representing the lower limit is small and indicates the great importance of not allowing even a little gasoline to be exposed in a room, because of the small quantity of vapor needed to make an explosive mixture with all the air in the room. If 1 gallon of gasoline is allowed to change completely into vapor simply by exposing it to the room air, and if the room is gastight, the 1 gallon can render explosive 2,100 cubic feet of air, the amount contained in a room measuring 21 by 10 by 10 feet.

In the actual use of gasoline such conditions seldom exist. However, an assumed case may be that of a person filling an open pail from a larger tank or using gasoline for cleaning. When the pail is first filled with the gasoline, a small volume of pure gasoline vapor forms over the surface of the gasoline. Just above this layer of pure gasoline vapor is a mixture of vapor and air; at some point there will be an explosive proportion, and farther away from the pail there will be a small proportion of vapor, and finally still farther away no vapor at all, but pure air. However, all the time the user of the gasoline is at work, the vapor keeps forming, from both the gasoline in the pail and that applied to the object being cleaned, rendering more and more air inflammable or explosive, until finally there will exist a dangerous atmosphere that may completely surround him, so that a chance ignition will envelope him in flames and perhaps cause great damage to property. Ignition of the gasoline vapor may take place even some distance from the gasoline in a room adjoining the room in which the person works. As the gasoline evaporates, and more and more vapor is given off, it mixes with air farther and farther from the gasoline and, if the evaporation lasts long enough, may travel to an adjoining room, where it may be ignited. On ignition a sharp flash will travel back through the adjoining room to the room where the gasoline is.

From Technical Paper 127, Bureau of Mines.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

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THE NATION'S ENGINEERS TO HELP.

The following letter, dated January 13, was addressed by President Wilson to Mr. W. L. Saunders, President of the American Institute of Mining Engineers and Vice-Chairman of the Naval Consulting Board:

"The work which the American Institute of Mining Engineers has done through its members on the Naval Consulting Board is a patriotic service which is deeply appreciated."

"It has been so valuable that I am tempted to ask that you will request the Institute to enlarge its usefulness to the government still further, by nominating for the approval of the Secretary of the Navy a representative from its membership for each state in the Union to act in conjunction with representatives from the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers, and the American Chemical Society, for the purpose of assisting the Naval Consulting Board in the work of collecting data for use in organizing the manufacturing resources of the country for the public service in case of emergency, I am sure that I may count upon your cordial co-operation."

"With sincere regards, cordially yours,

"WOODROW WILSON."

This letter is so clear and right to the point that no explanation can make it clearer, and little more need be said until definite action is taken in the direction indicated. A representative of each of the National Societies will be appointed for each of the States, and these men will be in touch with the local industries. They will be able to list all industrial plants whose output would be of use in time of war. This would cover not merely actual fighting material, offensive or defensive, but all that goes for sustenance, transportation, etc. The Navy and War Departments will thus be made familiar with the industrial resources of the country, and will know at once where to place orders as they may be required. These plants may always be provided with plans and specifications in advance, and thus may anticipate and provide for national preparedness.

COMPRESSED AIR AND THE RAILROADS

Compressed air has done much for the railroads, and in return it may be said that the railroads have done much for compressed air,

while the developments in reciprocal helpfulness are as active as ever. Next to the locomotive itself, the air brake is to the railroad a prime necessity for safe, successful, profitable operation, to say nothing of what air does in the switch and signal service.

The universal adoption of the air brake, and, incidentally with that, the presence of spare air brake pumps, or automatic air compressors, in railroad shops generally, making it easy for railroad men everyyhere to command a ready working supply of compressed air, has induced in railroad men the habit of thinking of compressed air as an ever ready help, not only in times of trouble but more still in everyday work, and has led to the employment of it for many improvised labor saving devices which have successively been generally adopted, not only in the railroad shop but in all the industries, even in those with which primarily the railroads have little to do.

One thing leads to another continually, and the specific employments of compressed air are increasing, perhaps at no time more rapidly than at present. The pneumatic hammer has developed a numerous progeny which has overflowed the shops and now is spreading over the entire field of outdoor engineering. It was, as we may now see, sure in the near future of a job on the track work, the maintenance of way, of the railroad, and the interesting story of its success in this line is now being told. The pneumatic tie tamper has proved an immediate success. It relieves the track workers of their most tiring task and does the work better, quicker, cheaper.

This leads at once to the portable air compressor, and this, too, is now provided. In the smallest size built it is of sufficient capacity to amply supply two tie tampers anywhere, and, being operated by a gasoline engine, it is ready for work at a minute's notice and costs nothing to keep going except when actually at work. The entire apparatus is mounted on a light car which is easily run along the road to points within short hose lengths and can be put on or off the track like the ordinary hand car.

Here again one thing leads to another, or rather to several others, just as any precedent cause is followed by more than one effect. This portable compressor supplies the breath of life not only to the tie tampers but to hammers, drills, grinders that are now often required. Grinding switch points is now a familiar operation, also drilling holes occasionally where a new length of rail is laid, etc. Further developments along these lines may be confidently expected.

SCREW PIPE JOINTS

It is not often that so much which is the reverse of correct is crowded into so short a paragraph as the following, which we clip from an anonymous exchange:

"There are a lot of foolish ideas about pipe dope for threads when screwing the pipe together. It is not the dope that makes the joint tight, but the fact that the pipe is screwed together with a lubricant that will prevent the friction from heating the threads. A good graphite grease is as good as anything and the pipe is always easily unscrewed when graphite is used. Always put the compound in the female thread and not on the male."

It *is* the "dope" that makes the joint tight, and that is what it is used for. If the joint is made without the dope it will certainly leak, and if proper dope is properly applied it will not leak. As to the friction and heating effect of slowly screwing a pipe joint once together, that is nonsense. There is no objection to graphite for the dope. Whatever is used should be placed on the male thread and not in the female. If the latter practice is followed some of the dope will be shoved ahead into the pipe to harden and form an obstruction, slight, perhaps, for a single joint, but something serious on a long line.

A COMPRESSOR EXPLOSION.

A gas engine air-compressor casualty is recorded in the newly issued Factory (British) Inspector's Report, in which two men were killed in Staffordshire by an explosion of an air receiver connected with a power-driven compressor used for the starting of three large gas engines. It appeared that the explosion was due to ignition of a mixture of air and finely-divided lubricating oil. This oil was of high flash-point, specially made for compressors, and the compressor was effectively water cooled, but it had been run for an exceptionally long time, and had probably become hotter than usual. The explosion apparently originated at the point where the discharge pipe joined the compressor, and this pipe was liable to get very hot.

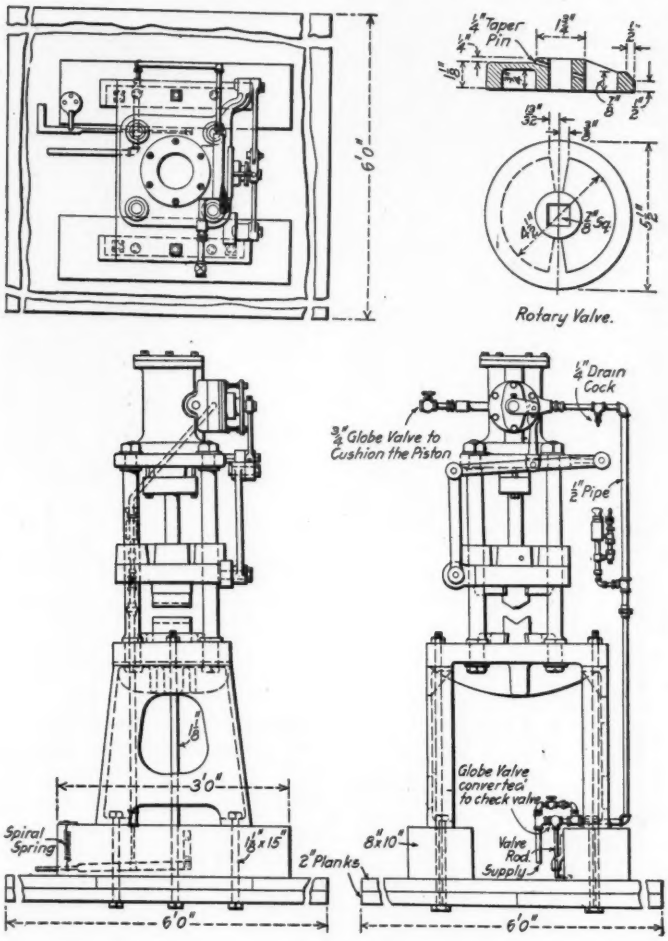


FIG. 2.

A PNEUMATIC BLACKSMITH HAMMER

An ingenious and serviceable air hammer has been devised by William Baird, shop superintendent of the Plattsmouth, Neb., car shops of the Chicago, Burlington & Quincy, for welding bolts and for hammering out scrapped rods to rods of smaller diameter. The photograph Fig. 1 shows one of these hammers located adjacent to a furnace and used for welding bolts. At the base of the hammer, may be seen the two pieces of a bolt before it is welded and a finished bolt. The hammer will make 250 strokes per minute and 650 bolts are welded in an eight-hour day. Bolts from 7/8 in. to 1 1/4 in. are handled in this machine.

The construction of the machine is shown in the drawing Fig. 2. The cylinder is supported on four columns, 2 1/4 in. in diameter. These columns are bolted to an anvil block 18 in. by

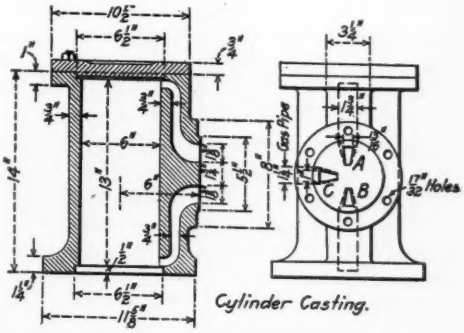


FIG. 3.

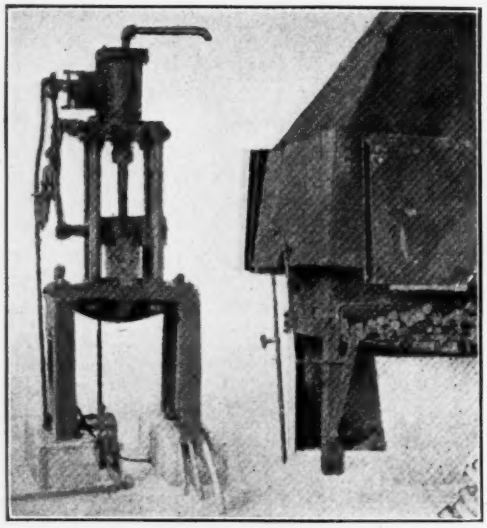


FIG. I.

28 in. by 3 in. thick, which is reinforced with a 3-in. rib. running lengthwise of the block. This block rests on a cast-iron frame, which in turn is bolted to two blocks, 8 in. by 10 in. These blocks are again bolted to a base 6 ft. square made up of two courses of 2-in. plank.

The cylinder has a bore of 6 in. and provides for a stroke of about 10 in. The piston is 2⅝ in. thick, being designed for three packing rings ⅜ in. thick. The piston rod is 2 ½ in. in diameter and has a taper fit in the hammer. The air supply to the cylinder is regulated by a rotary valve operated by the link motion shown in the side view of the hammer. The valve itself is also shown among the details of the machine. It has one blind and one open chamber which alternately cover the ports *A* and *B*, shown in the side view of the cylinder. The port *C* is the exhaust and is constantly under the blind chamber of the rotary valve. Air is admitted to the cylinder from the valve chest through the open chamber and the ports *A* and *B*. The exhaust pipe is provided with a globe valve for the purpose of restricting the exhaust sufficiently to give a cushioning effect to the piston at the end of the stroke. The air to the valve chest is controlled by a pedal valve at the base of the machine. This valve is by-passed for the purpose of keeping a constant pressure under the hammer, thus holding it in its "up" position when it is not working.

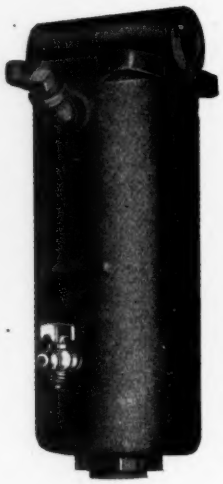
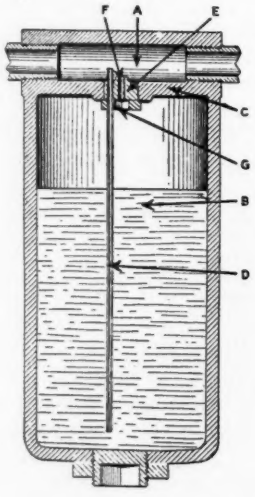


FIG. I.

TO PREVENT THE FREEZING OF AIR BRAKE PIPES

Frozen air brake apparatus is sometimes a serious trouble when atmospheric temperatures run low, and to prevent this the rectifier here shown has been put on the market by the National Safety Device & Manufacturing Company, Chicago. We are informed that it was thoroughly tested in actual service through the winter of 1914-15 with results entirely satisfactory. It not only prevented the freezing but in addition softened the accumulations of grease, gum and oil



within the pipe system in a way beneficial to the working of the valves.

The apparatus consists of a malleable iron body 4½ in. in diameter and 12½ in. long, weighing 19 lb. This is connected into the piping leading from the air storage tanks to the engineer's valve. The air has an unobstructed flow through the passage at the top so that no braking function is interfered with in any way. The freezing is prevented by the automatic mixing of very small amounts of alcohol, or other satisfactory medium, with the normal moisture in the air pipe system, which in addition to raising the temperature lowers the freezing point, thereby preventing the formation of ice particles.

It has been found by experiment that the following alcohol and water mixtures give the freezing points here indicated:

Water, Per Cent	Alcohol, Per Cent	Freezing Point, Deg. Fahr.
100	..	32
80	20	10
70	30	— 5
60	40	—20
50	50	—35

About three pints of alcohol, either grain alcohol or denatured alcohol, which is much cheaper and equally satisfactory, may be placed in the receiver at one time, and this will usually last from three or four weeks to three months.

The action is essentially similar to that of an ordinary atomizer. When the pressure in the pipe line is reduced, say, from 80 to 70 lb., by the operation of the engineer's valve, a minute portion of alcohol is carried into the air brake pipe system.

Referring to Fig. 1, it will be seen that there are two compartments: A, which is an enlargment of the transverse air passage, and B the alcohol reservoir. Communication between the two is through a fine brass tube D securely attached to the brass bushing E. This tube extends from a point about ¼ in. above the bottom of the air passage A to within about ½ in. of the bottom of the reservoir chamber B. In the brass bushing E is an equalizing vent F and an automatic non-return valve G. In the fluctuations of pressure which occur in the service pipe the pressure above the body of alcohol is sometimes sufficiently above the pressure in chamber A to allow a little of the alcohol to be carried up and be discharged into the flowing air.

While primarily the device was designed for use during the winter months it may of course remain all the year round, with or without its charge of alcohol. If the supply of alcohol is kept up during the warm months it will improve the braking service by keeping the oil, grease, and gum cut, thus giving a freer valve operation.

MINING ENGINEERS IN THE WAR

An official dispatch from Sir John French, pays the following tribute to the mining engineers, of whom more than 600 are at the front:

"I desire to call your lordship's attention to the splendid work carried out by the tunneling companies. These companies, officered largely by mining engineers, and manned by professional miners, have devoted themselves whole-heartedly to the dangerous work of offensive and defensive mining, a task ever accompanied by great and unseen dangers. It is impossible within the limits of a dispatch to give any just idea of the work of these units, but it will be found, when their history comes to be written, that it will present a story of danger, of heroism, and of difficulties surmounted worthy of the best traditions of the Royal Engineers, under whose general direction their work is carried out."

THE FLOTATION PARADOX

Flotation is a paradox. In a flowing mixture of finely pulverized ore and water it causes the heavy metallic sulphides to float to the surface, where they are collected for further metallurgical treatment, while the light barren gangue sinks to the bottom and is run into the tailing-pond. This apparent reversal of the attraction of gravitation is due to the introduction into the flowing mixture of a small quantity of oil or other emollient in such a manner that every particle of the ore, whether metallic, or gangue, is brought into contact with the oil, whereupon there is what seems a selective action between the oil and the metallic particles such that these become coated with the oil, whereas there is no such action of the oil upon the gangue. Under proper conditions, at or about the same time that this oil coating of the metallic particles takes place,

there may be caused to appear in the flowing mixture bubbles of air. These attach themselves to the oil-coated metallic particles and stick to them with more or less tenacity, making a new entity consisting of metallic particle, oil-coating and air-bubble. The specific gravity of this entity is less than that of the water of the flowing mixture; thereupon, because of the attraction of gravitation, and not in spite of it, the heavy metallic sulphides float to the surface and the comparatively light gangue sinks to the bottom, neither oil nor bubbles having any tendency to attach themselves to the barren gangue.—*Dudley H. Norris, in Mining Press.*

PNEUMATIC METHOD FOR MEASURING HIDES

A new German process just patented in this country for measuring the area of hides, makes use of a pneumatic method instead of the mechanical methods which have heretofore been in vogue. It is claimed for the pneumatic process that it is quicker and more accurate than anything that has yet been devised. A table top mounted on a funnel base has many perforations of equal size, placed at regular intervals. A suction fan draws its supply through these holes, and the skin to be measured being placed upon this table, causes a reduction of the air current cross section. Thus a rarification of the air with a resultant measurable sub-pressure is created which serves for a calculation of the area of the hide which is resting on the perforated plate. This figure is indicated by the combined readings of a vacuum gage and the tachometer arranged together at a convenient point over the table.—*Scientific American.*

MINIATURE AIR MOTORS FOR MODEL AEROPLANES

Although miniature motors operated by compressed air are not a novelty in the field of model flying machines, still a new type which has just made its appearance is sufficiently different from the others to command passing comment. It is a five-cylinder rotary type and weighs but four ounces with propeller and mounting frame. On 15 pounds pressure the motor will turn over at 1,000 r. p. m. The bore of the cylinders is 11/32 inch and the stroke 7/16 inch. The "overhand" method is used in mounting the motor on model aeroplanes. With the exception of the valve springs, the entire motor, mounting frame and tank are made of brass.

AIR TO HELP OIL WELLS

Increasing the production of oil wells by forcing air down one of the wells, is being tried in parts of West Virginia. This forces the oil to the adjacent wells. In one case a well that had been making less than a barrel per day was brought up to eight barrels by this method, and other wells have had their production increased 200 or 300%. One objection to the use of this method is that it is a patented process and a comparatively large royalty is required.

NOTES

The new tunnel at Waiahole, Hawaii, which was recently opened, carries 125,000,000 gallons of water daily, and 3,000 acres of cane land will get the benefit of the water supply.

While making more than 16 miles an hour the battleship "Wyoming" recently took on oil from the collier "Cyclops" by means of a pipe extended between the two vessels.

What may be called a pocket blasting machine is being introduced. It will supply current for firing from three to five blasting caps by a sharp twist to its handle. It measures 4½ by 3⅝ by 2⅛ inches and weighs 4½ pounds.

In acetylene lamps for mines, one ounce of good carbide makes about 500 cu. in. of acetylene gas. An ordinary miners' carbide lamp uses nearly half an ounce of carbide per hour, making up to 0.144 cu. ft. of gas.

The lowest barometric reading ever recorded in the United States (*i. e.*, as reduced to

sea level and standard gravity) is said to have been that registered at New Orleans during the hurricane of September 29th last, when the pressure fell to 28.11 inches.

Mine timber should have the bark stripped off before being shaped and put in place. By hand a man can peel up to 60 logs per day, but by using a pneumatic hammer with suitable chisel up to 200 per day can be done. When the bark is removed rotting can be detected.

The moving picture industry is using a large amount of silver. There are about 20,000 picture houses in the United States, using approximately 120,000,000 feet of film regularly. The average life of a film is three weeks. It is estimated that 15,000,000 ounces of silver per year—a figure equal to Utah's total production—are used for sensitizing.

Instead of the customary cornerstone setting, a silver rivet was driven, of course by pneumatic hammer, into the steel work of a 26-story building being erected at Madison Avenue and Forty-second Street, New York City, by August Heckscher. When the building is completed the rivet will be exposed in a silver lined recess in the main entrance lobby.

At a cost of at least several million dollars for smelting improvements Anaconda Copper Co. has at last reached a stage in its operations where its net recovery of all metal values in the ore is better than 95%. By the adoption of the flotation process less than 2 lb. of copper per ton is lost as compared with former losses of 10 and 12 lb. In 1913 it cost Anaconda $1.85 per ton to smelt its ore; today the cost is $1.14.

Grouting is now an established method of stopping flows of water in shafts, adits, and drifts. A mixture of cement and water, say a bag of cement to three 12-qt. pails of water, with sometimes a little sand, is forced by a grout-machine into holes drilled in the rock, the pressure being furnished by compressed air. Pressure of 100 to 200 lb. above the hydrostatic head is used in difficult shaft problems. The Nova Scotia Steel & Coal Co., in its iron mine at Bell Island, Newfoundland, where the mine workings are several miles out under the ocean, has a grout-car run on wheels that can force grout into rock at pressures as high as 700 lb. per square inch. By use of this grout-car the workings, although under the Atlantic ocean, are kept fairly free from large flows of water.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents,

DECEMBER 7.

1,162,819. VACUUM FUEL-FEEDING SYSTEM. HAROLD C. SUCKERT, New York, N. Y.

1,162,826. FLUID-PRESSURE BRAKE. WALTER V. TURNER, Edgewood, Pa.

1,162,844. PNEUMATIC MILKING-MACHINE. OSCAR ANDERSON, Lancaster, Pa.

1,162,851. FLUID-COMPRESSOR. EDWARD H. DEWSON, New York, N. Y.

1,162,881. SUSPENSION DEVICE FOR FLUID-COMPRESSORS. WALTER J. RICHARDS, Milwaukee, Wis.

1,162,884. AIR-COMPRESSOR. CLAUDE RORABECK, Dayton, Ohio.

1,162,912. WINDMILL. CHARLES L. GULLEY and WILLIAM L. MANN, St. Joseph, Mo.

1,162,962. ROTARY AIR COMPRESSOR OR PUMP. EDWARD WILSON, St. Louis, Mo.

1,162,964. ROCK-DRILL. WARREN WOOD, Paterson, N. J.

1,163,129. AIR-COOLING SYSTEM FOR INTERNAL-COMBUSTION ENGINES. AURIN M. CHASE, Syracuse, N. Y.

1,163,161. MILKING - MACHINE. MEREDITH LEITCH, Poughkeepsie, N. Y.

1,163,270-1. METHOD OF IMPREGNATING TIMBER. GRANT B. SHIPLEY, Pittsburgh, Pa.

1. The process of treating wood consisting in subjecting the wood to air pressure, and without relieving the air pressure subjecting the same to a bath of a preserving composition under a pressure higher than the air pressure, withdrawing the preserving composition and immediately subjecting the wood to a partial vacuum, thereby extracting a portion of water and composition, and then coating the wood with a waterproofing composition.

1,163,330. FLUID-OPERATED MOTOR. MARTIN V. B ETHRIDGE, Brooklyn, N. Y.

1,163,419. PNEUMATIC CUSHION. IRVING A. LAKE, New York, N. Y.

1,163,471. VALVE. ADOLPH W. SCHRAMM, Riverton, N. J.

4. The combination of a casing connected to a source of air under pressure; a main valve for controlling the flow of air to the casing; a tubular plunger mounted to engage and operate the valve and having a relief opening leading to the outside of the casing; and a valve operable by the plunger for closing communication between the relief opening thereof and the atmosphere before the main valve can be opened.

1,163,543. ROTARY BLOWER. ROBERT A. ILG, Chicago, Ill.

DECEMBER 14.

1,163,650. FURNACE-BURNER. GEORGE L. FOGLER, Pittsburgh, Pa.

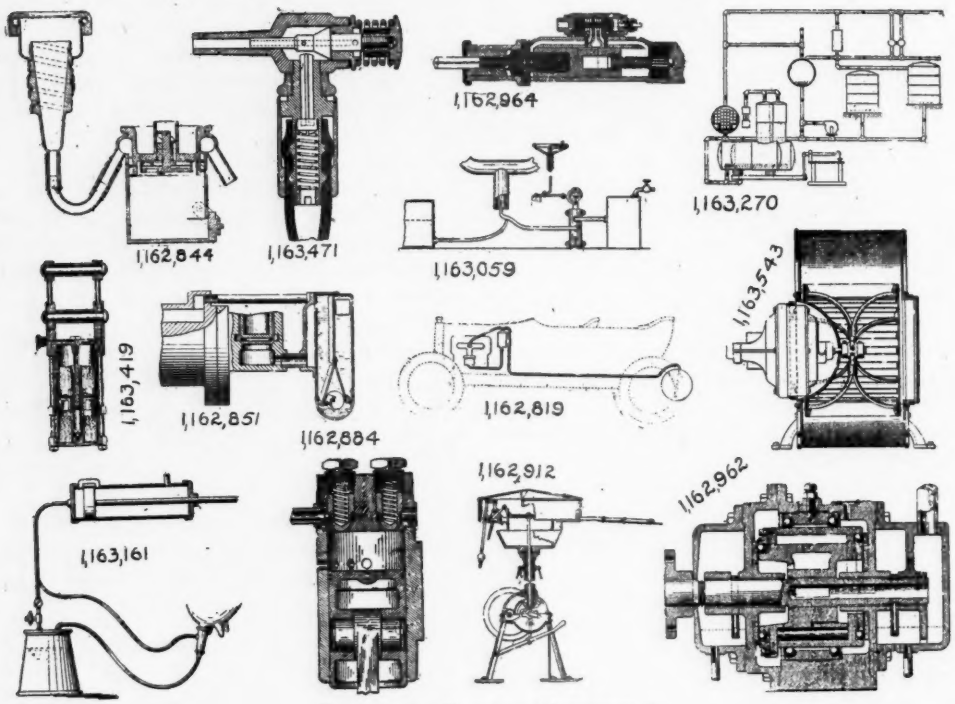
1,163,754. METHOD OF DRAWING GLASS. HALBERT K. HITCHCOCK, Tarentum, Pa.

1,163,768. TUBULAR OZONE-GENATOR. MARIUS PAUL OTTO, Paris, France.

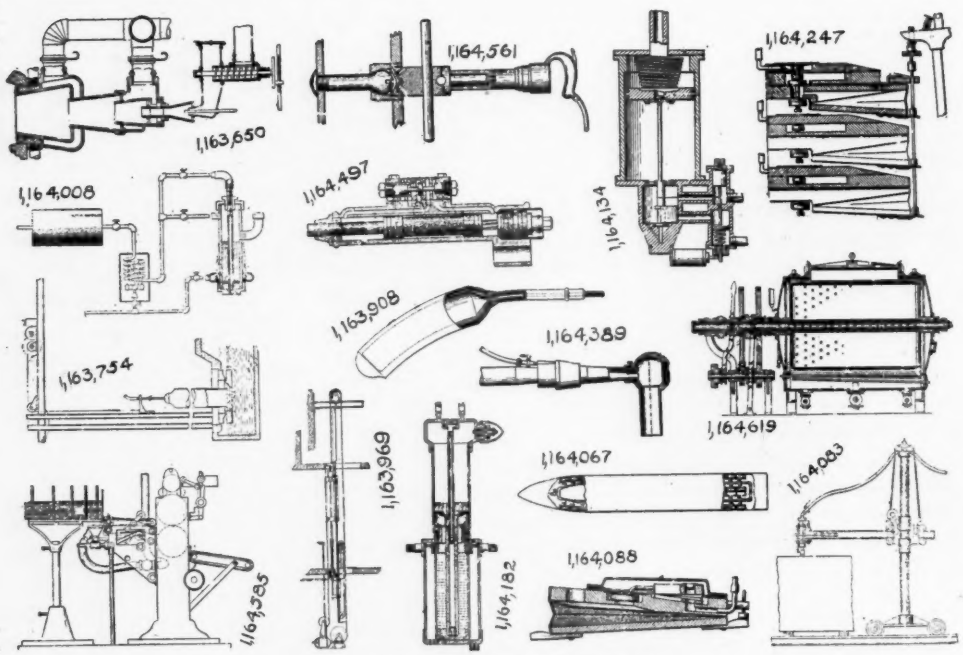
1,163,908. AIR-BAG. RICHARD T. GRIFFITH, Akron, Ohio.

1,163,969. APPARATUS FOR DRAWING GLASS TUBES, BENJAMIN DAY CHAMBERLIN, Corning, N. Y.

1,164,008. METAL - SPRAYING PROCESS. RALPH W. E. MOORE, Swissvale, Pa.



PNEUMATIC PATENTS DECEMBER 7.



PNEUMATIC PATENTS DECEMBER 14.

2. The method of producing a metallic coating which consists in projecting a stream of air or gas at a high velocity into contact with a stream of molten metal, whereby said metal is caused to impinge against a heated deflecting surface and is sub-divided into fine particles which are projected upon the body to be coated.

1,164,067. APPARATUS FOR RAISING SUBMERGED BODIES. HARRY BYRNS, Hamilton, Ontario, Canada.

1,164,083. STONEWORKING - MACHINE. GEORGE H. GILMAN, Claremont, N. H.

1,164,088. VALVE-SEAT FOR PNEUMATIC APPARATUS. ADOLPH P. GUSTAFSON, Chicago, Ill.

1,164,098. VACUUM-VALVE. SAMUEL A. KINSEY, Jr., Peoria, Ill.

1,164,105. MEANS FOR DEAERATING AND COOLING THE DRIVING MEDIUM OF HYDRAULIC GEARS. HUGO LENTZ, Halensee, near Berlin, Germany.

1,164,134. ELECTROPNEUMATIC APPARATUS. JESSE M. STANSELL and CHARLES D. OLAND, Centralia, Ill.

1,164,139-40. PROCESS OF ATOMIZING AND BURNING HYDROCARBONS. CHARLES VIVION STUART, Memphis, Tenn.

DECEMBER 21.

1,164,632. PNEUMATIC ACTION. JOSEPH COURVILLE, Detroit, Mich.

1,164,709. EMERGENCY - VALVE ATTACHMENT FOR AIR-BRAKE SYSTEMS. HARRY ENOCH and GEORGE M. POINT, Huntington, W. Va.

1,164,758. TRAIN-STOPPING DEVICE. HIRAM G. SEDGWICK, Mill Valley, Cal.

1,165,024. COMBINED GRAVITY AND FLUID-PRESSURE SANDER FOR LOCOMOTIVES. EDWIN A. RIVES, Greensboro, N. C.

1,165,040. TANK APPARATUS FOR PNEUMATIC CLEANERS. ALBERT E. TOLIN, Anderson, Ind.

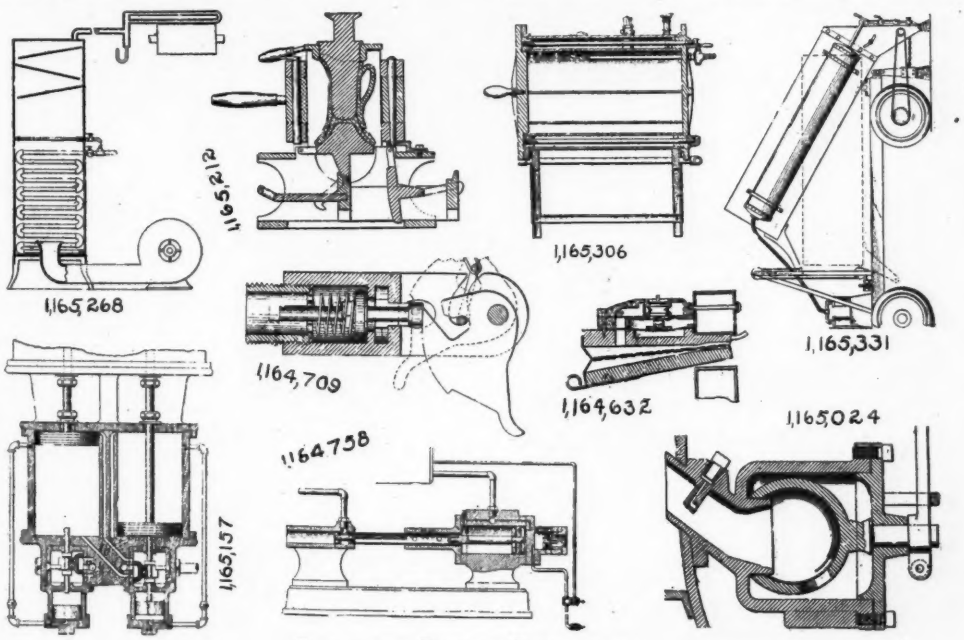
1,165,157. AIR-PUMP. JOHN A. DREEHOUSE and FRED L. DREEHOUSE, Laramie, Wyo.

1,165,212. MANUFACTURE OF HOLLOW GLASS ARTICLES. THEODORE C. STEIMER, Knoxville, Pa.

1,165,268. MOISTENING APPARATUS. EINAR MATHESON, Woodland, Me.

1,165,306. VACUUM-DRIER. HARRY E. ALLEN and FRANK T. MITCHELL, Washington, D. C.

1,165,331. ROAD - SANDING APPARATUS. GRANVILLE H. GRAY, Los Angeles, Cal.



PNEUMATIC PATENTS DECEMBER 21.

1,164,182. VEHICLE AIR-SPRING. JONATHAN S. GREEN, Pittsburg, Pa.

1,164,247. PNEUMATIC POWER DEVICE. AUGUST YOUNG, New York, N. Y.

1,164,389. SAND-BLAST. EDWARD D. O'BRIEN, Seattle, Wash.

1,164,496. ROCK-DRILL. GEORGE H. GILMAN, Claremont, N. H.

1,164,497. PRESSURE-ACTUATED VALVE. GEORGE H. GILMAN, Claremont, N. H.

1,164,561. PNEUMATIC WRENCH FOR APPLYING AND REMOVING FLUSH CAPS FOR FLEXIBLE STAYS. CHARLES P. WHELAN, Syracuse, N. Y.

1,164,585. PNEUMATIC FEEDER FOR PRESSES. JAMES DUVALL, Camas, Wash.

1,164,619. VACUO - CENTRIFUGAL FIBER AND FABRIC TREATING MACHINE. HERBERT P. JEFFERSON, Boston, Mass.

DECEMBER 28.

1,165,562. SUCTION-MACHINE. JOHN WYNN, Jr., Canton, Ohio.

1,165,639. ELECTROPNEUMATIC BRAKE APPARATUS. WALTER V. TURNER, Edgewood, Pa.

1,165,691. PROCESS OF PREPARING HOLES FOR BLASTING. WILLIAM H. MASON, Easton, Pa.

2. The process of forming a small diameter hole in calcinable rock, applying heat within said hole to the rock to calcine the same, hydrating the calcined material, and flushing it out with water, substantially as set forth.

1,165,715. MEANS FOR CONTROLLING THE QUANTITY AND QUALITY OF THE PRODUCTION OF GAS. JOHN M. RUSBY, Philadelphia, Pa.

1,165,794. TURBINE-BLOWER. WILLIAM MC CLAVE, Scranton, Pa.

1,165,826. METHOD OF GENERATING AND CONTROLLING PRESSURE. EDWARD T. YOUNG, Milton, Mass.

2. A method of operating internal combustion engines which consists in confining air in a combustion chamber heated to a temperature above the temperature of ignition of the fuel whereby said air will be heated sufficiently to ignite fuel, and introducing the fuel into said air in any desired increasing quantity during the first portion of the working stroke of the piston whereby any desired maximum working pressure may be secured and maintained during the introduction of the fuel.

1,165,876. PRESSURE - INDICATING MECHANISM FOR PNEUMATIC-TIRED VEHICLES. WILBER E. HEBERLING, Youngstown, Ohio.

1,165,901. VENT-VALVE FOR FLUID-RESERVOIRS. BYRON S. RANDALL, Hustisford, Wis.

1,165,931. CENTRIFUGAL FAN OR PUMP. NICHOLAS W. AKIMOFF, Philadelphia, Pa.

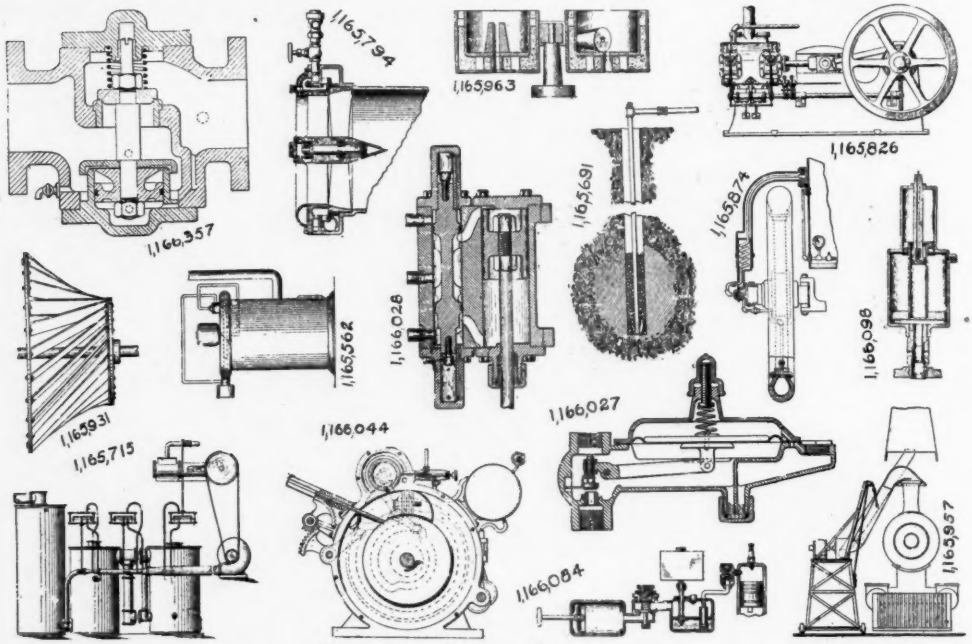
1,166,044. ROTARY FLUID-PRESSURE MOTOR. FRANCIS M. FLOYD, Elkville, Ill.

1,166,070. GAGE FOR INDICATING FLUID-PRESSURES. COLEMAN J. MANNING, Medford, Mass.

1,166,084. STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES. MALCOLM P. RYDER, Springfield, Mass.

1,166,098. PUMP. WILLIAM U. WATSON, Chicago, Ill.

1. A compressor having a motor cylinder, a piston, a cylindrically chambered nipple leading to said cylinder for supplying gas thereto, said nipple having a port at the side arranged radially and in a plane transverse to the length of the nipple, and a cylindrical valve sliding in said nipple to cover and uncover said port, said valve having a passage extending longitudinally through it and constricting somewhat the size of the passage in the nipple whereby a gas stream flowing longitudinally through the nipple moves said valve.



PNEUMATIC PATENTS DECEMBER 28.

1,165,957. PORTABLE LOCOMOTIVE-DRAFTING DEVICE. ARTHUR J. FILKINS, Riverside, Ill.

1,165,963. AIR-DUCT FOR GLASS-DRAWING POTS AND METHOD OF LIBERATING AND SETTING THE SAME. ROBERT L. FRINK, Lancaster, Ohio.

1,166,027. PRESSURE-REGULATOR. EDWIN C. WEISGERBER and FREDERICK C. LEINROTH, Pittsburgh, Pa.

1,166,028. FLUID - MOTOR. CHARLES CLAUDE WILKINSON, Salem, Ohio.

1,166,040. APPARATUS FOR LINING TUBES. WILLIAM BURLINGHAM, Newport News, Va.

1. In a percussive tube-lining tool, a pneumatic tool cylinder, a hammering piston within the cylinder, and a plurality of resilient arms supported on said cylinder, the outer extremities of which are externally formed into conoidal segmental surfaces, whereby a compact, spheroidal hammer surface is formed, the inner walls of said arms being shaped so as to coact with the forward end of said piston and be rapidly vibrated thereby.

1,166,125. GLASS-DRAWING MECHANISM. ROBERT L. FRINK, Cleveland, Ohio.

1,166,357. PRESSURE-REDUCING VALVE. JOHN GRAHAM, Glasgow, Scotland.

1,166,358. FLUID-PRESSURE REGULATOR. PATRICK MATHEW GRANT, Chicago, Ill.

1,166,365. PUMP. CHARLES TAYLOR HARDING, Fayetteville, Ark.

1. The herein described pump mechanism comprising a casing through which water is adapted to circulate, at rotary pump within the casing to cause positive circulation of the water, an air pump within the casing and spaced from the other wall thereof whereby the water circulates around it within the casing, means to operate the rotary pump, and means to cause the air pump to be connected in the same operating mechanism for simultaneous action.

1,166,369. TIRE-SETTING MACHINE. HENRY T. HENDERSON, Keokuk, Iowa.

1,166,407. AIR-BRAKE - HOSE COUPLING. WILLIAM ERNEST BENN, McAdam Junction, New Brunswick, Canada.

1,166,415. PNEUMATIC COUPLING. AARON J. TYLER, Rochester, N. Y.